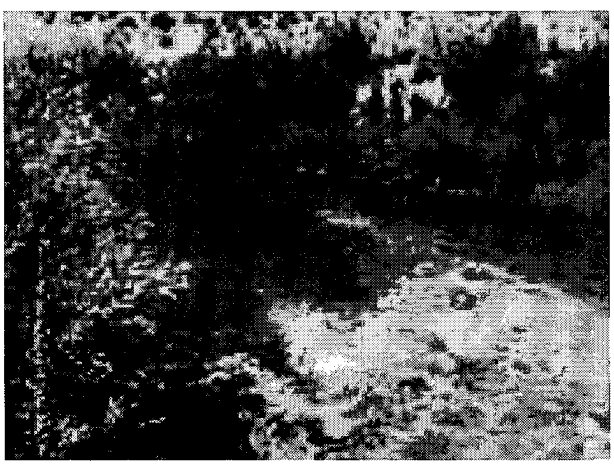
Total Maximum Daily Loads for East Fork Owyhee River and Mill Creek

May 2005

Submitted to EPA Region IX, May 10, 2005
Approved by EPA Region IX, June 30, 2005

Mill Creek above EF Owyhee River



East Fork Owyhee River below Mill Creek

Covered Parameters

East Fork Owyhee River

Copper (dissolved)
Iron (total)
Phosphorus (total)
Temperature
Total Suspended Solids
Turbidity

Mill Creek

Cadmium (dissolved and total)
Copper (dissolved and total)
Dissolved Oxygen
Iron (total)
pH
Phosphorus (total)
Temperature
Total Dissolved Solids
Total Suspended Solids
Turbidity

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Executive Summary

Section 303(d) of the Clean Water Act requires each state to develop a list of water bodies that need additional work beyond existing controls to achieve or maintain water quality standards, and submit an updated list to the Environmental Protection Agency (EPA) every two years. The Section 303(d) List provides a comprehensive inventory of water bodies impaired by all sources. CFR (Code of Federal Regulations) 40 Part 130.7 require states to develop TMDLs (Total Maximum Daily Loads) for the waterbody/pollutant combinations appearing in the 303(d) List.

The East Fork Owyhee River (Wildhorse Reservoir to Mill Creek), first appeared on the 1996 303(d) list for total phosphorus, total dissolved solids (TDS), total suspended solids (TSS), turbidity and iron. In 1998, the lower reach of the East Fork Owyhee River (Mill Creek to Duck Valley Reservation) was added to the list for the same pollutants. The decision to include these water bodies on the 1996 and 1998 303(d) Lists were based upon data and information collected by NDEP (Nevada Division of Environmental Protection). In 2002, the listing for the upper reach of the East Fork Owyhee River (Wildhorse Reservoir to Mill Creek) was expanded (based upon NDEP data) to include temperature. In 2002, Mill Creek was added to the 303(d) List due to exceedances of the cadmium (total), copper (dissolved and total), dissolved oxygen, iron (total), phosphorus, total dissolved solids, total suspended solids, temperature, turbidity and pH standards. Listing decisions for the 2002 303(d) List were based solely on NDEP data. Due to an oversight, data collected by RTWG (Rio Tinto Working Group) had not been utilized during the 2002 303(d) List generation. After consideration of the RTWG data along with NDEP data, additional parameters are expected to be added to the updated 2004 303(d) List (Table E-1).

Table E-1. Summary of 2002 303(d) List pertaining to East Fork Owyhee River and Mill Creek

Waterbody Name	Reach Description	Pollutant or Stressor of Concern
East Fork Owyhee River	Wildhorse Reservoir to Mill Creek	Iron (total)
		Temperature
		Total phosphorus
		Total Suspended Solids
		Turbidity
	Mill Creek to Duck Valley Indian Reservation	Copper (dissolved) *
		Iron (total) *
		Temperature *
		Total phosphorus
		Total Suspended Solids
		Turbidity
Mill Creek	Above East Fork Owyhee River	Cadmium (dissolved) *
		Cadmium (total)
		Copper (dissolved)
		Copper (total)
		Dissolved oxygen
		Iron (total)
		pH
		Temperature
		Total dissolved solids
		Total phosphorus
		Total Suspended Solids
		Turbidity

* Parameters expected to be added to the updated 2004 303(d) List.

For each of these pollutants of concern, this report includes a discussion for the following categories:

- Problem Statement
- Source Analysis
- Target Analysis
- Pollutant Load Capacity and Allocation
- Future Needs

While the Rio Tinto Mine area is a known contributor for several of the pollutants addressed in this document, there are also other natural and human-caused sources within the watershed. For example, exceedances of the iron and phosphorus water quality standards are common throughout the entire state given that these constituents commonly occur in Nevada soils. Natural erosion in the watershed and the stream channel, and erosion from dirt roads, trails, mining activities, grazing, etc. can lead to increased levels of phosphorus, iron, total suspended solids and turbidity.

The TMDLs and load allocations presented in this report are in a form unique for Nevada. Through the use of equations, the defined TMDLs and load allocations vary with flow thereby addressing the EPA requirement to consider seasonal variations and critical flow conditions in the TMDL process.

During the development of this TMDL document, a number of issues and future needs were identified:

- A detailed source assessment including quantity, location, timing may be necessary for some of the identified pollutants of concern. A differentiation between natural and human-caused sources is needed for some pollutants.
- More detailed monitoring may be appropriate for certain constituents (dissolved oxygen, temperature) to verify that exceedances of the standards are actually occurring to an extent warranting concern.
- An evaluation of the appropriateness of "municipal or domestic supply" as a beneficial use for Mill Creek may be appropriate.
- Some of the water quality standards need to be reviewed and possibly revised to appropriate levels. Standards should be set for Mill Creek which recognize its ephemeral nature.
- As additional data are collected: 1) update the linear regression relationship between total suspended solids and turbidity; 2) update extreme low and high flow statistics; and 3) update average annual flows and associate average annual TMDLs/LAs.

As time and resources allow, the Nevada Division of Environmental Protection will address these needs and update the TMDLs as appropriate.

Total Maximum Daily Loads for East Fork Owyhee River and Mill Creek

1.0 Introduction

1.1 Background

Section 303(d) of the Clean Water Act requires each state to develop a list of water bodies that need additional work beyond existing controls to achieve or maintain water quality standards, and submit an updated list to the Environmental Protection Agency (EPA) every two years. The Section 303(d) List provides a comprehensive inventory of water bodies impaired by all sources. This inventory is the basis for targeting water bodies for watershed-based solutions, and the TMDL (Total Maximum Daily Load) process provides an organized framework to develop these solutions. CFR (Code of Federal Regulations) 40 Part 130.7 require states to develop TMDLs for the waterbody/pollutant combinations appearing in the 303(d) List.

The East Fork Owyhee River and Mill Creek are listed for cadmium (dissolved and total), copper (dissolved and total), dissolved oxygen, iron (total), pH, phosphorus (total), temperature, total dissolved solids, total suspended solids and turbidity. As required by the Clean Water Act, this document presents TMDLs for these listed parameters.

1.2 Total Maximum Daily Load (TMDL) Defined

TMDLs are an assessment of the amount of pollutant a water body can receive and not violate water quality standards. Also, TMDLs provide a means to integrate the management of both point and nonpoint sources of pollution through the establishment of waste load allocations for point source discharges and load allocations for nonpoint sources. TMDLs are to be established at levels necessary to attain and maintain the applicable narrative and numerical water quality standards with consideration given to seasonal variations and a margin of safety.

Once approved by the U.S. Environmental Protection Agency, TMDLs are implemented through existing National Pollutant Discharge Elimination System (NPDES) permits for point source discharges to achieve the necessary pollutant reductions. Nonpoint source TMDLs can be implemented through voluntary or regulatory nonpoint source control programs, depending on the state. In Nevada, the nonpoint source program is voluntary.

While each TMDL report is unique, many contain similar elements. Following is a discussion of the typical components that appear in TMDLs based upon EPA guidance (EPA, August 1999).

1.2.1 Problem Statement: The objective of the problem statement is to describe the key factors and background information that describes the nature of the impairment, such as chemical water quality, biological integrity, physical condition, etc.

1.2.2 Source Analysis: As part of a source analysis, the known loading sources (both point and nonpoint sources) are characterized by location, type, frequency, and magnitude to the extent possible. In the case of nonpoint sources, characterization activities can require significant financial resources.

1.2.3 Target Analysis: Section 303(d) (1) of the Clean Water Act states that TMDLs "shall be established at a level necessary to implement the applicable water quality standards." A purpose of the target analysis is to identify those future conditions needed for compliance with the water quality standards and for support of the beneficial use. According to the U.S. EPA (1999), one of the primary goals of target analyses are to clarify whether the ultimate goal of the TMDL is to comply with a numeric water quality criterion, comply with an interpretation of a narrative water quality criterion, or attain a desired condition that supports meeting a specified designated use.

1.2.4 Pollutant Load Capacity and Allocation: Another component is the identification of the waterbody loading capacity. The loading capacity is the maximum amount of pollutant loading a waterbody can assimilate without violating TMDL target. The allowable loadings are then distributed or "allocated" among the significant sources of the pollutant.

If appropriate, a margin of safety is included in the analysis to account for uncertainty in the relationship between pollutant loads and the water quality of the receiving water. It can also be stated that the margin of safety is to account for uncertainties in meeting the water quality standards when the target and TMDL are met. Additionally, consideration needs to be given to seasonal variations and critical conditions. The general equation describing the TMDL with the allocation and margin of safety components is given below:

$$TMDL = Sum\ of\ WLA + Sum\ LA + Margin\ of\ Safety \quad (Eq.\ 1)$$

Where:

Sum of WLA = sum of wasteload allocations given to point sources
Sum of LA = sum of load allocations given to nonpoint sources

According to 40 CFR 130.2(i), TMDLs need not be expressed in pounds per day when alternative means are better suited for the waterbody problem.

1.2.5 Other Components: TMDL submittals often include a plan for TMDL implementation and for monitoring TMDL effectiveness. In Nevada, the TMDL is implemented through NPDES permits for point sources and through Nevada 319 Nonpoint Source Program for nonpoint sources of impairment.

2.0 Background and Problem Statement

2.1 Study Area

The East Fork Owyhee River, a tributary of the Snake River, originates in northeastern Nevada and flows in a northwesterly direction through the Duck Valley Indian Reservation and into Idaho (Figure 1). Since 1938, the flow of the East Fork Owyhee River has been regulated by Wild Horse Reservoir (Moore and Eakin, 1968). Irrigation is the primary water usage in the watershed with about 3,000 to 4,000 acres irrigated upstream of the Duck Valley Indian Reservation (NRCE, 1992). Mill Creek is one of several tributaries of the East Fork Owyhee River and is located about 1.5 miles south of Mountain City in northwest Elko County. Land uses in the East Fork Owyhee watershed (above Duck Valley Indian Reservation) include grazing, irrigation, recreation, and mining, as well as the town of Mountain City, with primary landownership including U.S. Forest Service, Bureau of Land Management and private.

2.1.1 Active Dischargers Within East Fork Owyhee River and Mill Creek: A survey of the Nevada Bureau of Water Pollution Control's permits database, indicates that no NPDES (National Pollutant Discharge Elimination System) permits have been issued for point source discharges to the East Fork Owyhee River or Mill Creek. However, a temporary permit and an active groundwater discharge permit were identified and are listed in Table 1. Under NDEP's (Nevada Division of Environmental Protection) direction, remediation activities are currently underway to mitigate water quality problems resulting from runoff and seepage from the tailings piles. The "rolling stock" permit allows for construction equipment to enter the Mill Creek channel as needed to construct identified structures for improved site stability and tailings impoundment at the abandoned Rio Tinto mine site.

Table 1. Active Discharges within the East Fork Owyhee River and Mill Creek

Permit Number	Permittee	Facility Type	Discharge
TNEV 2000410	Rio Tinto Working Group	Construction (Rolling Stock)	Mill Creek
NEV 40023	Mountain City, NV	Municipal Wastewater Treatment	Groundwater

Source: Nevada Bureau of Water Pollution Control files

2.1.2 Rio Tinto Mine and its Impact on Water Quality: The Rio Tinto Mine Site is an abandoned copper mine located approximately 2.5 miles south of Mountain City, in northern Elko County, Nevada. Underground mining of a rich, copper-sulfide ore deposit started in 1932. After the high-grade ores were exhausted, the mine closed in 1947. During the ensuing years there were a number of operations at the site that included reworking the old tailings, leaching stockpiles of ore, leaching the underground workings, and exploration for additional mineral deposits (Temkin Wielga & Hardt LLP, 2004).

Acid mine drainage and groundwater contamination from the Rio Tinto mine, has adversely impacted the water quality of Mill Creek and the East Fork Owyhee River. However, efforts are currently underway to address the problem. In the early 1990s, the Rio Tinto Working Group (RTWG) was formed to address concerns raised by the U.S. Environmental Protection Agency, State of Nevada, the U.S. Forest Service, the Shoshone-Paiute Tribes and locals. These groups are working together to develop appropriate remediation actions.

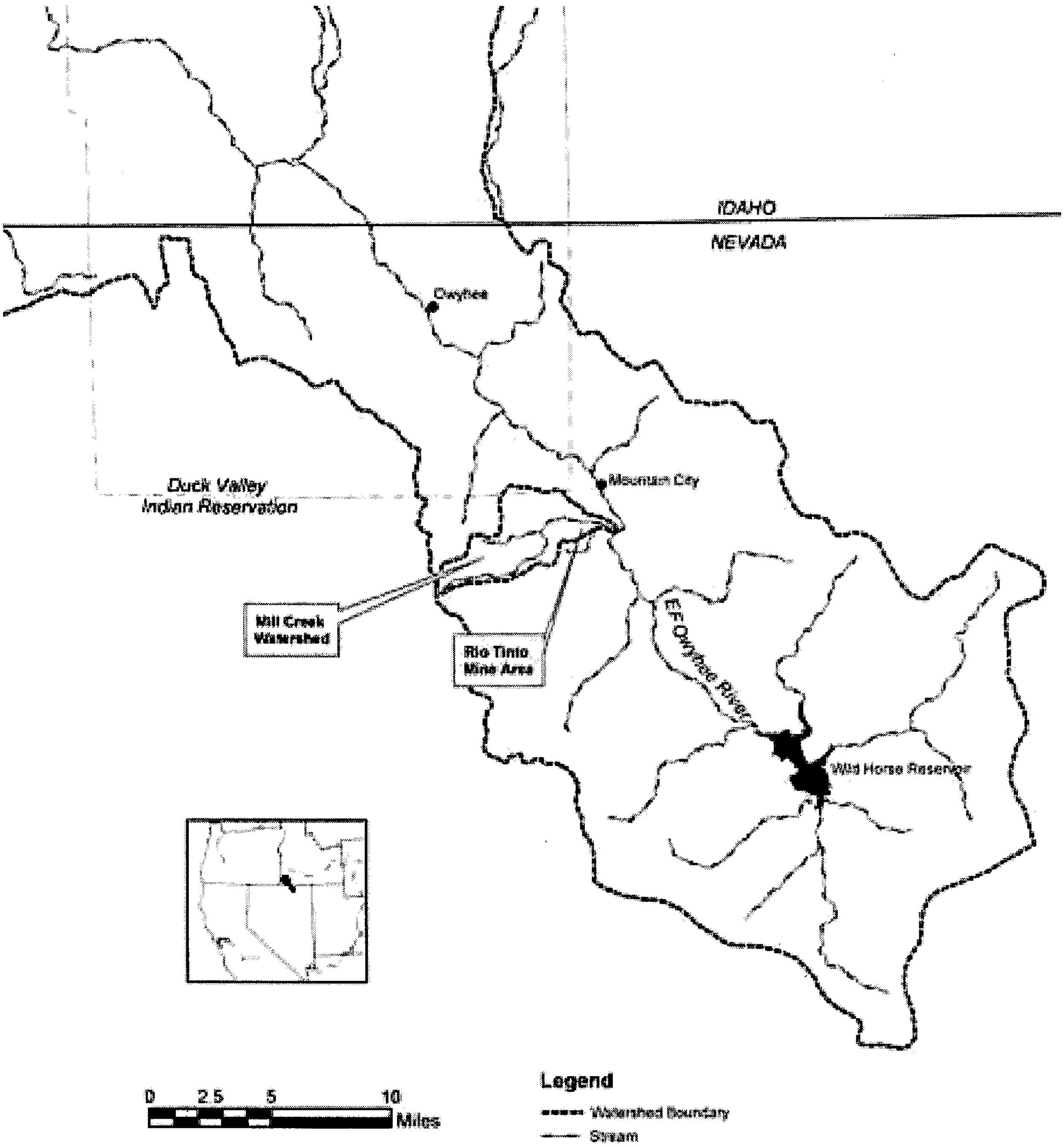


Figure 1. East Fork Owyhee River and Mill Creek Location Map

2.2 *Water Quality Standards and Their Applicability*

2.2.1 East Fork Owyhee River and Mill Creek Water Quality Standards: Nevada's water quality standards, contained in the Nevada Administrative Code (NAC) 445A.119 – 445A.225, define the water quality goals for a waterbody by: 1) designating beneficial uses of the water; and 2) setting criteria necessary to protect the beneficial uses. Beneficial uses consist of such things as irrigation, recreation, aquatic life, fisheries, irrigation and drinking water. Per NAC 445A.214, the designated beneficial uses for the East Fork Owyhee River consist of[1]:

- Irrigation
- Watering of livestock
- Recreation involving contact with the water
- Recreation not involving contact with water
- Industrial supply
- Municipal or domestic supply or both
- Propagation of wildlife
- Propagation of aquatic life

Applicable numeric standards for the East Fork Owyhee River and Mill Creek can be found in the Nevada regulations summarized in Table 2 and Figure 2.

Table 2. Summary of NAC References for Numeric Standards related to EF Owyhee River and Mill Creek

Waterbody	Reach	General Numeric Standards	Toxics Standards
EF Owyhee River	From Wild Horse Reservoir to Mill Creek	NAC 445A.222	NAC 445A.144
	From Mill Creek to Duck Valley Indian Reservation	NAC 445A.223	
Mill Creek	Entire waterbody	NAC 445A.223 (under tributary rule - NAC 445A.123)	

Currently, Nevada has not set specific water quality standards for Mill Creek. However, pursuant to NAC 445A.145 "Control Points: Prescription and Applicability of Numerical Standards for Water Quality; Designation of Beneficial Uses"(e.g." Tributary Rule"), surface waters upstream from the control point or to the next upstream control point or to the next water named in NAC 445A.123, are subject to the standards at the control point where the standards are specified. Because of this "Tributary Rule", Mill Creek is subject to the same beneficial use water quality standards (including the same beneficial uses and numeric criteria) stated in NAC 445A.223.

[1] Under the Tributary Rule, the same beneficial uses apply to Mill Creek. According to Nevada's Continuing Planning Process document, "The applicability of water quality standards to tributaries in a watershed is assumed to apply to waters that maintain a surface hydrologic connection for some period of time during the year not just in response to infrequent storm events. The hydrologic connection must be for a long enough period that there is a commingling of water and an exchange of beneficial uses, in particular aquatic life, is possible." (NDEP, December 2002)

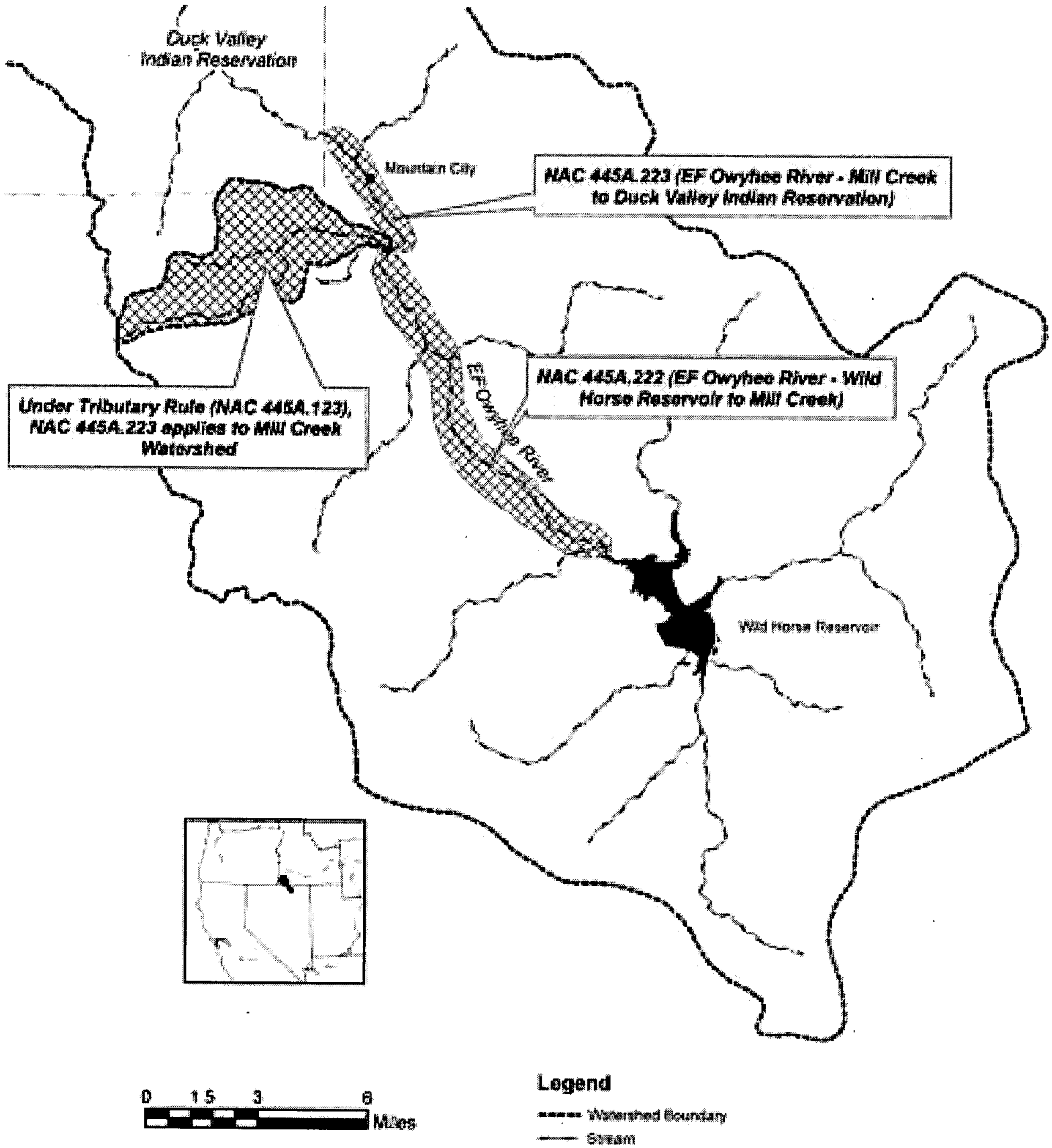


Figure 2. Waterbody Reaches Identified in Nevada Water Quality Regulations

The numeric standards for the toxics cadmium, copper and iron are summarized in Table 3 and include concentrations associated with both the "dissolved" and "total" components, if applicable, and the designated beneficial use. The numeric standards for phosphorus, total dissolved solids, total suspended solids, turbidity, temperature and pH are summarized in Table 4 and the designated beneficial use.

The Shoshone-Paiute Tribes of the Duck Valley Reservation are currently in the process of developing water quality standards for the EF Owyhee River within the Duck Valley Reservation. The East Fork Owyhee River-Mill Creek TMDL document only addresses those portions of these waterbodies that are outside the reservation boundary.

Table 3. Cadmium, Copper and Iron Standards for East Fork Owyhee River and Mill Creek

Parameter		Most Restrictive Beneficial Use	Numeric Standard (µg/l)	Comments
Cadmium	Total	Municipal or Domestic Supply	5	
Copper	Dissolved	Aquatic Life 1-hour average	$0.85*e^{(0.9422*\ln(H)-1.464)}$	If Hardness = 50 mg/l, Standard = 8 µg/l If Hardness = 200 mg/l, Standard =29 µg/l
		Aquatic Life 96-hour average	$0.85*e^{(0.8545*\ln(H)-1.465)}$	If Hardness = 50 mg/l, Standard =6 µg/l If Hardness = 200 mg/l, Standard =18 µg/l
	Total	Irrigation	200	
Iron	Total	Aquatic Life	1,000	

Source: NAC 445A.144

e = 2.718, H = Hardness as $CaCO_3$ (calcium carbonate) mg/l

Table 4. Dissolved Oxygen, Total Phosphorus, Total Suspended Solids, Turbidity and Temperature Standards for East Fork Owyhee River and Mill Creek

Parameter	Most Restrictive Beneficial Use	Numeric Standard (°C, mg/l or NTU)	Comments
Dissolved Oxygen	Aquatic Life	> 6.0 mg/l	
Total Phosphorus	Aquatic Life	< 0.10 mg/l	
Total Dissolved Solids	Municipal or Domestic Supply	< 500 mg/l	
Total Suspended Solids	Aquatic Life	< 25 mg/l	
Turbidity	Aquatic Life	< 10 NTU	
Temperature	Aquatic Life	< 7°C	November - April
		< 21°C	May - October
pH	Aquatic Life	Between 6.5 and 9.0	

Source: NAC 445A.222 through 445A.223

2.2.2 Water Quality Standards Applicability during Extreme Events: Nevada Administrative Code 445A.121(8) states, "The specified standards are not considered violated when the natural conditions of the receiving water are outside the established limits, including periods of extreme high or low flow ...." Therefore, water chemistry data associated with samples collected during extreme high and low flows[2] were not considered when determining the level of impairment. Table 5 summarizes the flow thresholds used in this TMDL document for characterizing standard exceedance frequency. For all streams, the water quality standards are not applicable during periods of zero flow. As additional data are collected, these numbers can be revised for future phases of the TMDL.

Table 5. Extreme Low and High Flow Thresholds for EF Owyhee River and Mill Creek

Waterbody	Reach	7Q10 Low (cfs)	7Q10 High (cfs)	Flow Gage (See Section 2.4.2)
EF Owyhee River	Wild Horse Reservoir to Mill Creek	0.1	542	13174500
	Mill Creek to Duck Valley Indian Reservation	2.65	930	13175100
Mill Creek	Above Rio Tinto Mine site	0.03	107	SW-1 & SW-2
	Below Rio Tinto Mine site			

2.3 303(d) Listing

The East Fork Owyhee River (Wildhorse Reservoir to Mill Creek), first appeared on the 1996 303(d) list for total phosphorus, total dissolved solids (TDS), total suspended solids (TSS), turbidity and iron. In 1998, the lower reach of the East Fork Owyhee River (Mill Creek to Duck Valley Reservation) was added to the list for the same pollutants. The decision to include these water bodies on the 1996 and 1998 303(d) Lists were based upon data and information collected by NDEP. In 2002, the listing for the upper reach of the East Fork Owyhee River (Wildhorse Reservoir to Mill Creek) was expanded (based upon NDEP data) to include temperature.

In 2002, Mill Creek was added to the 303(d) List due to exceedences of the cadmium (total), copper (dissolved and total), dissolved oxygen, iron (total), phosphorus, total dissolved solids, total suspended solids, temperature, turbidity and pH standards.

Listing decisions for the 2002 303(d) List were based solely on NDEP data. Due to an oversight, data collected by RTWG (Rio Tinto Working Group) had not been utilized during the 2002 303(d) List generation. After consideration of the RTWG data along with NDEP data, additional parameters are expected to be added to the updated 2004 303(d) List (Table 6).

[2] In setting extreme low and high flow thresholds, NDEP typically uses $7Q10_{high}$ and $7Q10_{low}$ values. The 7Q10 flows are developed from historic streamflow data and are defined as a predicted high or low flow for a consecutive seven day period with an expected recurrence interval of ten years. With no continuous flow measuring device on Mill Creek, there are insufficient data to develop the 7Q10 statistics. However, a review of statistics for other flow gaging stations in the state indicate that the 2nd percentile (2% of the flows are less than this value) and 98th percentile (98% of the flows are greater than this value) are fair approximations of the 7Q10 statistics. Using RTWG spot flow measurements for SW-1 and SW-2 (combined) and interpolated for missing months, the 2nd percentile and 98th percentile were calculated and used as estimates of Mill Creek $7Q10_{high}$ and $7Q10_{low}$, respectively.

Table 6. Summary of 2002 303(d) List pertaining to East Fork Owyhee River and Mill Creek

Waterbody Name	Reach Description	Pollutant or Stressor of Concern
East Fork Owyhee River	Wildhorse Reservoir to Mill Creek	Iron (total)
		Temperature
		Total phosphorus
		Total Suspended Solids
		Turbidity
	Mill Creek to Duck Valley Indian Reservation	Copper (dissolved) *
		Iron (total) *
		Temperature *
		Total phosphorus
		Total Suspended Solids
		Turbidity
Mill Creek	Above East Fork Owyhee River	Cadmium (dissolved) *
		Cadmium (total)
		Copper (dissolved)
		Copper (total)
		Dissolved oxygen
		Iron (total)
		pH
		Temperature
		Total dissolved solids
		Total phosphorus
		Total Suspended Solids
		Turbidity

* Parameters expected to be added to the updated 2004 303(d) List.

2.4 Water Quantity and Quality

2.4.1. Primary Monitoring Stations: Table 7 provides a list of the primary stream flow gauging stations and water quality monitoring stations in the East Fork Owyhee River basin (Figure 3). Data collected at these stations were the primary source of flow and water quality information utilized in the development of this report. While additional data have been developed by other agencies, Table 7 represents those stations with the longest periods of record. Except for Sites #02 and #03, detailed water quality data are presented in the appendix. At Sites #02 and #03, water quality probes were operated for the continuous (readings every hour) monitoring of dissolved oxygen, temperature, and other parameters. Gaps in the data exist due to no flow conditions and mechanical failure.

2.4.2. Water Quantity: Surface water in the East Fork Owyhee River and Mill Creek is comprised primarily of direct runoff from rainfall and snowmelt. As shown in Figure 2 and presented in Table 7, two active USGS Stream Flow Gauge stations (#13175100 and #13174500) are located on the East Fork Owyhee. Station #13175100 is located inside the eastern boundary of the Duck Valley Reservation while Station #13174500 is located below Wildhorse Reservoir near Gold Creek.

Flow in the East Fork Owyhee River is regulated by the Wild Horse Reservoir[3] with an average annual flow of about 31,000 acre-feet per year (AFY) immediately below the reservoir (USGS Station 13174500) (Table 6). With a drainage area above this location of about 209 square miles, the average annual yield for this sub basin is about 153 acre-feet / square mile. Flows immediately below the reservoir are often near zero during the winter months as water is stored. However, flows typically

[3] Wild Horse Reservoir has a capacity of 71,500 acre-feet and provides water for irrigating approximately 12,000 acres of land on the Duck Valley Reservation (RTWG, September 2002).

Table 7. List of Selected Water Quantity and Water Quality Monitoring Stations for East Fork Owyhee River and Mill Creek

ID	Description	Agency	Period of Record
Stream flow Gauging Stations			
13174500	EF Owyhee River near Gold Creek, NV	USGS	1936-Present
SW-3	EF Owyhee River above Mill Creek	RTWG	1995-Present (spot measurements only)
SW-1	Mill Creek above Rio Tinto Mine area	RTWG	
SW-2	Mill Creek below Rio Tinto Mine area	RTWG	
SW-4	EF Owyhee River below Mill Creek	RTWG	
13175100	EF Owyhee River near Mountain City, NV	USGS	1991-95, 1997-Present
13176000	EF Owyhee River above China Diversion Dam near Owyhee, NV	USGS	1939-84 (Discontinued)
Water Quality Monitoring Stations			
E12	EF Owyhee River below Wildhorse Reservoir	Nevada	1996-Present
E4	EF Owyhee River above Mill Creek	Nevada	1979-Present
E14	Mill Creek below Rio Tinto Mine	Nevada	1997-Present
SW-3	EF Owyhee River above Mill Creek	RTWG	1995-Present
SW-1	Mill Creek above Rio Tinto Mine area	RTWG	
SW-2	Mill Creek below Rio Tinto Mine area	RTWG	
SW-4	EF Owyhee River below Mill Creek	RTWG	
E15	EF Owyhee River below Mill Creek	Nevada	2000-Present
E16	EF Owyhee River near Duck Valley Indian Reservation boundary	Nevada	
DV0100	EF Owyhee River at South Reservation Boundary	Shoshone-Paiute Tribes	1999-Present
Continuous Water Quality Monitoring Stations			
#02	Mill Creek below Hydraulic Control Pond (HCP)	Shoshone-Paiute Tribes	2000 (partial)
#03	Mill Creek above Highway 225	Shoshone-Paiute Tribes	2000-2004 (partial)

increase downstream as several tributaries flow into the Owyhee River. At USGS flow monitoring station #13176000, located approximately 2 miles southeast of Owyhee on the Duck Valley Indian Reservation, average annual flows increase to 108,000 acre-ft/year. The average annual yield for the watershed at this location is about 236 acre-feet per square mile (based upon drainage area of 458 square miles). Average annual streamflow values have been estimated for points between Wild Horse Reservoir and Duck Valley Indian Reservation (Table 8).

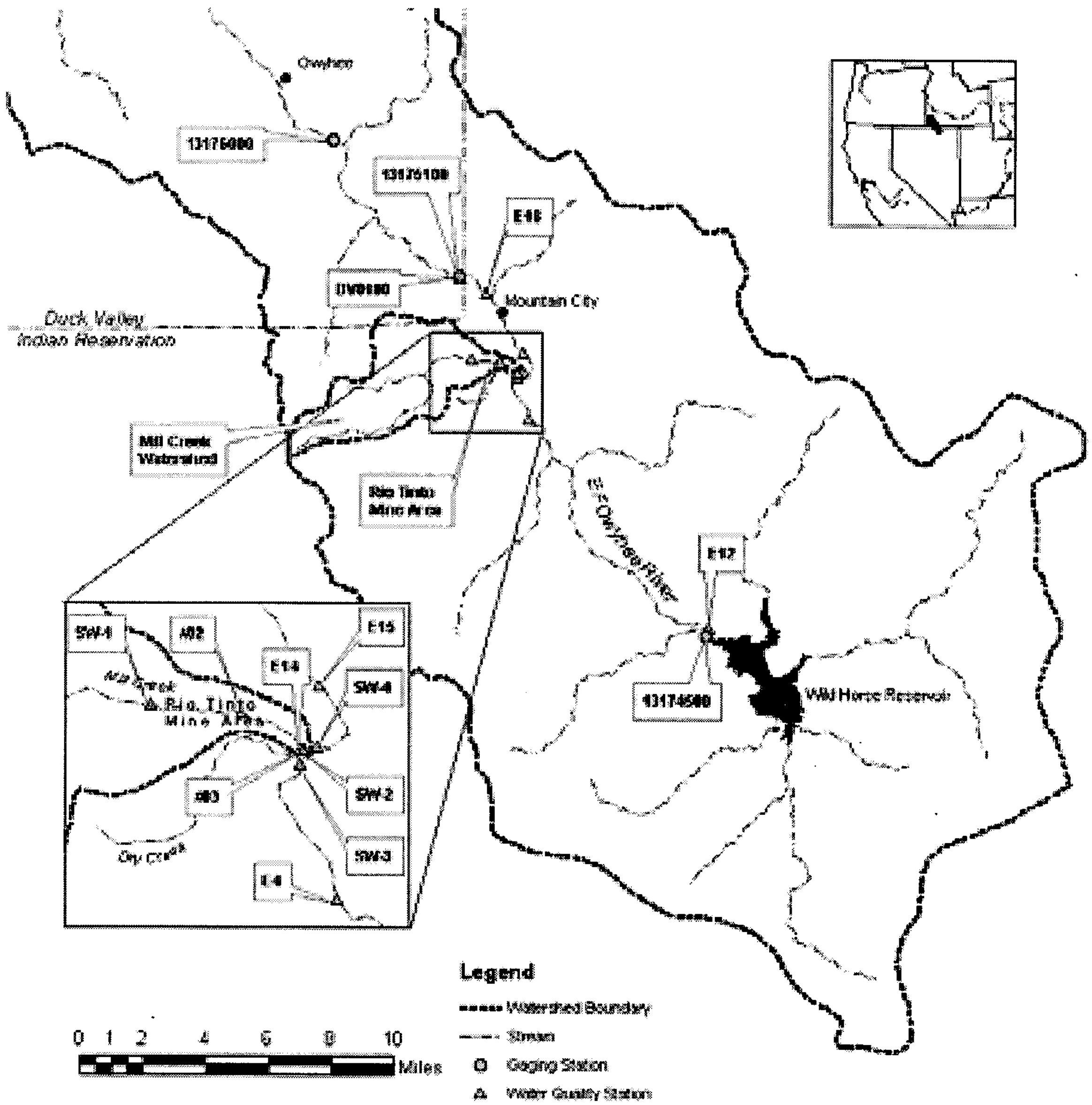


Figure 3. Selected Water Quantity and Quality Monitoring Stations for East Fork Owyhee River and Mill Creek

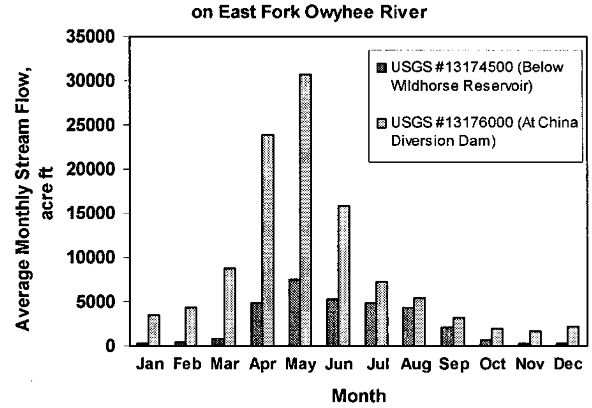
Table 8. Summary of Average Annual Streamflows (1937-2003)

Stream	Location (USGS gage)	Drainage Area (sq. miles)	Average Annual Flow, in acre-feet per year (cubic feet per second)	Yield (acre-feet per sq. mile)
EF Owyhee River	At Wild Horse Reservoir outlet (13174500)	209	31,000 (42.8)	149
	Above confluence with Mill Creek (13174900)	305	61,000 (84.3)	198
	At east boundary of Duck Valley Indian Reservation (13175100)	390	83,000 (114.6)	211
	Above China Dam Diversion (13176000)	458	108,000 (149.2)	235
Mill Creek	Above confluence with EF Owyhee River	15	3,000 (4.1)	200

Notes:
1. Drainage areas are as reported by USGS or estimated by NDEP.
2. 1937-2003 flows for 13174900, 13175100 and 1317800 estimated based upon regressions against flows at 13174500.
3. Average annual streamflow for Mill Creek estimated based upon an approximate yield of 200 AF/sq. mile and estimated watershed area of 15 square miles.

Figure 4 shows average monthly flow data for USGS flow gauge #13176000 (East Fork Owyhee at China Diversion Dam, 1939 through 1984) and USGS flow gauge #13174500 (East Fork Owyhee at Wildhorse Reservoir, 1916 through 2001). At the China Dam gauge, April, May and June are high flow months (e.g. flows greater than 10,000 acre-ft/month) with the May exhibiting the highest average monthly flow at 30,669 acre-ft/month. At the Wild Horse Reservoir gauge, April through August are high flow months (e.g. flows greater than 5,000 acre-ft/month) with the May exhibiting the highest average monthly flow (7,693 acre-ft/month). Flows immediately below the reservoir are frequently at or near zero during some winter days.

Figure 4. Average Monthly Stream Flow at Selected Sites on East Fork Owyhee River



During the mining activities of the 1930s, Mill Creek was diverted into an excavated channel on the south side of the valley, with mine waste material placed over the original channel and valley center. This channel is basically parallel to the original creek but is at a higher elevation. In this area, Mill Creek has been observed to be a losing stream with seepage from the creek flowing towards the mine waste material. It is not uncommon for Mill Creek to stop flowing during the months July through September (RTWG, 2002).

While no continuous flow data are collected on Mill Creek, the RTWG has been making periodic flow measurements at SW-1 and SW-2. For the period 1995-2003, flow measurements ranged from 0 to greater than 108 cfs. Based upon the limited data, it appears that a majority of the flow occurs in March through May with zero (and near zero) flows common in August through October.

2.4.3. Water Quality: As discussed earlier, the East Fork Owyhee River is included on Nevada's 2002 303(d) List due to exceedences of the total phosphorus, total iron, totals suspended solids, turbidity and temperature standards necessary for the propagation of aquatic life. In addition Mill Creek is included on Nevada's 2002 303(d) List due to exceedences of the above standards as well as total cadmium, total and dissolved copper, total dissolved solids, pH and dissolved oxygen. Existing water quality is discussed in greater detail in *Section 3.0 Total Maximum Daily Loads (TMDL).*

3.0 Total Maximum Daily Loads (TMDL)

3.1 Cadmium (Dissolved and Total) TMDL

3.1.1 Problem Statement: Tables 9 and 10 summarizes dissolved and total cadmium data as collected by NDEP and RTWG for Mill Creek. An evaluation of the data show that exceedances of the dissolved cadmium and total cadmium standards are frequent for Mill Creek below Rio Tinto Mine. No exceedances were identified in Mill Creek above the mine.

Table 9. NDEP and RTWG Dissolved Cadmium Water Quality Standards and Historic Data for Mill Creek (mg/l)

Parameter	Above Rio Tinto Site (SW-1)		Below Rio Tinto Site (SW-2)		Below Rio Tinto Site (E14)	
Period of Record	1995-97; 2001-03		1995-97; 2001-03		1997-2003	
No. of Samples	20		24		10	
No. of Samples (adjusted for extreme flows)	20		23		10	
Standard dependent upon hardness: NAC 445A.144 Standards For Toxic Materials Applicable To Designated Waters – for Aquatic Life						
% of Samples Exceeding Standard	1-hr Criteria	96-hour Criteria	1-hour Criteria	96-hour Criteria	1-hour Criteria	96-hour Criteria
	0%	0%	0%	48%	0%	40%
Average	BDL		0.0031		0.0051	
Median	BDL		0.0019		BDL	
Minimum	BDL		BDL		BDL	
Maximum	BDL		0.0191		0.0190	

BDL = below detection limit
Values reported as less than detection limit are assumed at ½ detection limit in calculating statistics. If calculations result in level below detection, denoted as BDL.

Table 10. NDEP and RTWG Total Recoverable Cadmium Water Quality Standards and Historic Data for Mill Creek (mg/l)

Parameter	Above Rio Tinto Site (SW-1)	Below Rio Tinto Site (SW-2)	Below Rio Tinto Site (E14)
Period of Record	1995-97; 2002-03	1995-97; 2002-03	1997-2003
No. of Samples	18	23	15
No. of Samples (adjusted for extreme flows)	18	21	14
Standard = 0.005 mg/l: NAC 445A.144 Standards For Toxic Materials Applicable To Designated Waters – for Municipal or Domestic Supply			
% of Samples Exceeding Standard	0%	10%	21%
Average	BDL	0.0030	0.0044
Median	BDL	0.0021	0.0020
Minimum	BDL	0.0002	BDL
Maximum	BDL	0.0172	0.0019

BDL = below detection limit
Values reported as less than detection limit are assumed at ½ detection limit in calculating statistics. If calculations result in level below detection, denoted as BDL.

For Mill Creek, most of the cadmium in the water column appeared in the dissolved form. Higher cadmium levels tend to occur during low flow periods in Mill Creek.

Based upon NDEP's data for 1997-2001, Mill Creek was placed on the 2002 303(d) List for total cadmium. Due to an oversight, data collected by RTWG (Rio Tinto Working Group) had not been utilized during the 2002 303(d) List generation. After consideration of the RTWG data along with additional NDEP data, dissolved cadmium is expected will be added to the updated 2004 303(d) List for Mill Creek. Therefore, TMDLs will be set for both dissolved and total cadmium for Mill Creek.

3.1.2 Source Analysis: The Rio Tinto Mine area is believed to be a major contributor of cadmium loads to Mill Creek. For the days RTWG sampled SW-1 and SW-2, about 80% of the cadmium loads (dissolved and total) to Mill Creek came from the watershed between SW-1 and SW-2 (Table 11). All of the SW-1 samples had levels "below detection limit." For these calculations, levels were assumed to be ½ of the detection limit. Therefore, the actual SW-1 loads (for sample days) could range from zero to double of those presented in Table.

Table 11. Average Mill Creek Cadmium Loads for Days Sampled by RTWG (pounds per day)

Parameter	Above Rio Tinto Site (SW-1)	Below Rio Tinto Site (SW-2)
Dissolved cadmium	0.007	0.032
Total cadmium	0.009	0.066

Notes:
1. All SW-1 samples had levels reported as "Below Detection Limit".
2. For samples reported as "Below Detection Limit", levels were assumed to be ½ of the detection limit.
3. Only days with flows greater than zero were included in calculations.
4. Information is provided to show the relative differences in loads between SW-1 and SW-2 and is NOT intended to provide an estimate of average annual loading at these locations.

3.1.3 Target Analysis: As discussed earlier, NAC 445A.144 sets 5 μg/l as the allowable total recoverable cadmium concentrations in Mill Creek through application of the tributary rule (NAC 445A.123). This standard has been set at a certain level as needed to ensure continued support of the associated beneficial use, being municipal or domestic water supply. While Mill Creek is not currently used as a drinking water source, "municipal or domestic water supply" has been identified as one of its designated or potential beneficial uses. As such, NAC 445A.144 criteria still apply. For the purposes of this TMDL, the total cadmium target has been set at 5 μg/l.

The cadmium standard of 5 μg/l coincides with EPA's cadmium MCL (Maximum Contaminant Level) under the Safe Drinking Water Act. EPA has found cadmium to potentially cause the following health effects when people are exposed to it at levels above the MCL for relatively short periods of time: nausea, vomiting, diarrhea, muscle cramps, salivation, sensory disturbances, liver injury, convulsions, shock and renal failure. Additionally, cadmium has the potential to cause the following effects from a lifetime exposure at levels above the MCL: kidney, liver, bone and blood damage.

As shown in NAC 445A.144, the acute (1-hour) and chronic (96-hour) dissolved cadmium standards vary with hardness with the chronic standard being the most restrictive:

$$\textit{96-hour dissolved cadmium standard (mg/l)} = 0.85*(2.718^{(0.7852*\ln(H)-3.490)}) / 1000 \quad (Eq.\ 2)$$

Where:

ln = natural logarithm
H = hardness as calcium carbonate (mg/l)

This standard was originally based upon recommendations in *Quality Criteria for Water* (EPA, 1986) for the protection of aquatic life. In developing the recommendations, EPA used the results of numerous acute and chronic toxicity tests for freshwater animals, including fish and macroinvertebrates. Of additional concern is the potential for cadmium to bioaccumulate[4] in aquatic life.

Equation 2 incorporates EPA's findings that dissolved cadmium is more toxic to aquatic life at lower hardness levels. Given that dissolved cadmium toxicity varies with hardness, one numeric value cannot be used for the TMDL target. For that reason, Equation 4 will serve as the dissolved cadmium target.

3.1.4 Pollutant Load Capacity and Allocation: The total cadmium Load Capacity or TMDL for Mill Creek (for any given flow) is represented by the following equation:

$$\textit{Dissolved Cadmium TMDL (lbs/day)} = \textit{Water Quality Target}_{Dissolved} \times \textit{Flow} \times 5.39 \quad (Eq.\ 3)$$

$$\textit{Total Cadmium TMDL (lbs/day)} = \textit{Water Quality Target}_{Total} \times \textit{Flow} \times 5.39 \quad (Eq.\ 4)$$

Where:

Water quality $target_{Dissolved} = 0.85*(2.718^{(0.7852*\ln(H)-3.490)}) / 1000$, mg/l
Water quality $target_{Total} = 0.005$ mg/l
Flow = streamflow, cubic feet per second
5.39 = conversion factor (converts equation results to pounds per day)

As the dissolved and total cadmium standards are applicable through the entire waterbody, these TMDL equations can be applied to any site on Mill Creek which has concurrent water quality and flow data. While the Rio Tinto area is recognized as the major source, the contribution from the watershed above Rio Tinto is uncertain. Therefore, a gross load allocation (LA) that accounts for all these sources has been set and is represented by the following equation:

$$\textit{Load Allocation (lbs/day)} = \textit{TMDL (lbs/day)} \times 0.90 \quad (Eq.\ 5)$$

In Equation 5, a Margin of Safety (MOS) of 10% has been selected to account for inaccuracies in flow measurements. The TMDL is intended to reflect adequate water quality needs across the entire range of flows rather than at a single flow, i.e. average flow. This has been accomplished through the use of the above equations whereby seasonal affects and critical conditions can be considered. It must be noted that the TMDLs/LAs calculated from these equations are not in effect during extreme low or high flows (see Table 5). Based upon estimated average annual flows and average hardness levels, average annual TMDLs/LAs for dissolved and total cadmium have been calculated for Mill Creek (Table 12).

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[4] Bioaccumulation occurs through uptake and retention of a substance from water only, through gill membranes or other external body surfaces. If the substances are not metabolized as fast as they are consumed, there can be significant magnification of potential toxicological effects up the food chain.

Table 12. Average Annual Dissolved and Total Cadmium TMDLs/LAs

Stream/ Location	Average Annual Flow (cfs)	Dissolved Cadmium				Total Cadmium		
		Average Hardness (as calcium carbonate, mg/l)	Target (mg/l)	TMDL (pounds/ day)	LA (pounds/ day)	Target (mg/l)	TMDL (pounds/ day)	LA (pounds/ day)
Mill Creek – at mouth	4.1	240	0.0019	0.042	0.038	0.005	22.1	19.9

In some instances, TMDL reports present estimates of load reductions needed for compliance with the load allocations. Unfortunately, there are insufficient data to accurately calculate Mill Creek historic loads and associated load reductions. However it can be stated that for TMDL compliance, load reductions are needed such that actual loads are at or below the Load Allocations (from Equation 5) at least 90% of the time (for total cadmium) or are not exceeded more than once in a three year period (for dissolved cadmium)[5]. In the absence of flow data, the TMDL is considered to be complied with when the total cadmium levels are below the target at least 90% of the time, or when the dissolved cadmium levels exceed the target no more than once in a three year period.

3.1.5 ***Future Needs:*** Following are future needs that have been identified for the cadmium TMDL and related activities:

- The appropriateness of "municipal or domestic supply" as a beneficial use for Mill Creek is questionable. Mill Creek is not currently used as a municipal or domestic drinking water source nor is it ever likely to be in the future. BWQP may need to consider undertaking a Use Attainability Analysis for this use on Mill Creek. At this time, a UAA for Mill Creek is not part of NDEP's 5-year plan and has not yet been scheduled.

- The current dissolved cadmium standards are outdated and need to be revised based upon the most recent EPA guidance (2002). The new equations developed by EPA result in 1-hour and 96-hour dissolved cadmium standards which are significantly lower (50% to 75%) than the current equations in NAC 445A.144. NDEP plans to review these standards and seek revisions during State Fiscal Year 2005.

3.2 Copper (Total and Dissolved) TMDL

Problem Statement: Tables 13-15 summarize total and dissolved copper data as collected by NDEP and RTWG on Mill Creek and show the frequency of exceedance of the water quality standards. Based upon NDEP's data for 1997-2001, Mill Creek was included on the 2002 303(d) List for dissolved and total copper. Due to an oversight, data collected by RTWG (Rio Tinto Working Group) had not been utilized during the 2002 303(d) List generation. After consideration of the RTWG data along with additional NDEP data, dissolved copper is expected to be added to the updated 2004 303(d) List for the East Fork Owyhee River below Mill Creek.

[5] As described in Nevada's 2002 303(d) List, waters are identified as impaired when the water quality standards are exceeded in more than 10% of the samples. For dissolved metals, waters are identified as impaired when the standards are exceeded more than once in any three-year period.

Table 13. NDEP and RTWG Dissolved Copper Water Quality Standards and Historic Data for EF Owyhee River (mg/l)

Parameter	Below Mill Creek (SW-4)		Below Mill Creek (E15)		At Duck Valley Indian Reservation (E16)	
Period of Record	1995-2003		2000-03		2000-03	
No. of Samples	61		9		9	
No. of Samples (adjusted for extreme flows)	61		9		9	
Standard Dependent on Hardness: NAC 445A.144 Standards For Toxic Materials Applicable To Designated Waters – for Aquatic Life						
% of Samples Exceeding Standard	1-hr Criteria	96-hour Criteria	1-hour Criteria	96-hour Criteria	1-hour Criteria	96-hour Criteria
	28%	41%	33%	33%	33%	33%
Average	0.0144		0.0244		BDL	
Median	0.0090		BDL		BDL	
Minimum	0.0002		BDL		BDL	
Maximum	0.0800		0.0600		0.0400	

BDL = below detection limit

Values reported as less than detection limit are assumed at ½ detection limit in calculating statistics. If calculations result in level below detection, denoted as BDL.

Table 14. NDEP and RTWG Dissolved Copper Water Quality Standards and Historic Data for Mill Creek (mg/l)

Parameter	Above Rio Tinto Site (SW-1)		Below Rio Tinto Site (SW-2)		Below Rio Tinto Site (E14)	
Period of Record	1995-2003		1995-2003		1998-2003	
No. of Samples	44		54		10	
No. of Samples (adjusted for extreme flows)	42		48		10	
Standard Dependent on Hardness: NAC 445A.144 Standards For Toxic Materials Applicable To Designated Waters – for Aquatic Life						
% of Samples Exceeding Standard	1-hr Criteria	96-hour Criteria	1-hour Criteria	96-hour Criteria	1-hour Criteria	96-hour Criteria
	0%	0%	71%	90%	90%	90%
Average	BDL		0.5209		1.264	
Median	BDL		0.0625		0.150	
Minimum	BDL		0.0090		0.020	
Maximum	0.0025		6.88		7.40	

BDL = below detection limit

Values reported as less than detection limit are assumed at ½ detection limit in calculating statistics. If calculations result in level below detection, denoted as BDL.

Table 15. NDEP and RTWG Total Copper Water Quality Standards and Historic Data for Mill Creek (mg/l)

Parameter	Above Rio Tinto Site (SW-1)	Below Rio Tinto Site (SW-2)	Below Rio Tinto Site (E14)
Period of Record	1995-2003	1995-2003	1997-2002
No. of Samples	44	54	15
No. of Samples (adjusted for extreme flows)	42	48	14
NAC Standard = 0.20 mg/l: NAC 445A.144 Standards For Toxic Materials Applicable To Designated Waters – for Irrigation Uses			
% of Samples Exceeding Standard	0%	77%	79%
Average	0.0048	1.0405	1.728
Median	0.0045	0.7265	0.900
Minimum	BDL	0.0480	0.138
Maximum	0.0380	7.31	7.500

BDL = below detection limit

Values reported as less than detection limit are assumed at ½ detection limit in calculating statistics. If calculations result in level below detection, denoted as BDL.

The NDEP and RTWG data show that exceedances of the total and dissolved copper beneficial use standards are common in Mill Creek below Rio Tinto and the East Fork Owyhee River below Mill Creek. While exceedance occur throughout the year under different flow regimes, the highest levels have generally occurred during the summer and late summer.

3.2.2 Source Analysis: The Rio Tinto Mine area is a known contributor of copper loads to Mill Creek and the East Fork Owyhee River. For the days RTWG sampled SW-1 and SW-2, approximately 98% of the copper loads (dissolved and total) to Mill Creek came from the watershed between SW-1 and SW-2 (Table 16).

Table 16. Average Mill Creek Copper Loads for Days Sampled by RTWG (pounds per day)

Parameter	Above Rio Tinto Site (SW-1)	Below Rio Tinto Site (SW-2)
Dissolved copper	0.2	8.3
Total copper	0.3	18.8

Notes:
1. For samples reported as "Below Detection Limit", levels were assumed to be ½ of the detection limit.
2. Only days with flows greater than zero were included in calculations.
3. Information is provided to show the relative differences in loads between SW-1 and SW-2 and is NOT intended to provide an estimate of average annual loading at these locations.

3.2.3 Target Analysis: As discussed earlier, NAC 445A.144 sets 200 µg/l as the allowable total recoverable copper concentrations in Mill Creek through application of the tributary rule. Based upon recommendations in *Water Quality Criteria* (National Academy of Sciences, 1972), this standard has been set at a certain level as needed to ensure continued support of the associated beneficial use, being irrigation.

According to the National Academy of Sciences:

> *"Based on toxicity levels in nutrient solutions and limited soils data available, a maximum concentration of 0.20 mg/l copper is recommended for continuous use on all soils."*

Therefore for the purposes of this TMDL, the total copper target has been set at 200 µg/l.

As shown in NAC 445A.144, the acute (1-hour) and chronic (96-hour) dissolved copper standards vary with hardness with the chronic standard being the most restrictive:

$$\text{96-hour dissolved copper standard (mg/l)} = 0.85*(2.718^{(0.8545*\ln(H)-1.465)})/1000 \qquad \text{(Eq. 6)}$$

Where:

ln = natural logarithm
H = hardness as calcium carbonate (mg/l)

This standard was originally based upon recommendations in *Quality Criteria for Water* (EPA, 1986) for the protection of aquatic life. In developing the recommendations, EPA used the results of numerous acute and chronic toxicity tests for freshwater animals, including fish and macroinvertebrates. Equation 6 incorporates EPA's findings that dissolved copper is more toxic to aquatic life at lower hardness levels. Given that dissolved copper toxicity varies with hardness, one numeric value cannot be used for the TMDL target. For that reason, Equation 6 will serve as the dissolved copper target.

3.2.4 Pollutant Load Capacity and Allocation: The dissolved and total copper Load Capacity or TMDLs for Mill Creek and the East Fork Owyhee River (for any given flow) are represented by the following equations:

Mill Creek only:

$$\text{Total copper TMDL (lbs/day)} = \text{Water Quality Target}_{Total} \times \text{Flow} \times 5.39 \quad \text{(Eq. 7)}$$

Mill Creek and EF OwyheeRiver below Mill Creek:

$$\text{Dissolved copper TMDL (lbs/day)} = \text{Water Quality Target}_{Dissolved} \times \text{Flow} \times 5.39 \quad \text{(Eq.8)}$$

Where:

Water Quality Target$_{Total}$ = 0.200 mg/l
Water Quality Target$_{Dissolved}$ = $0.85*(2.718^{(0.8545*\ln(H)-1.465)})/1000$, mg/l
Flow = streamflow, cubic feet per second
5.39 = conversion factor (converts equation results to pounds per day)

As the copper standards are applicable through the entire reach in question, these TMDL equations can be applied to any site on Mill Creek or on the East Fork Owyhee River (between Mill Creek and the Duck Valley Indian Reservation) which has concurrent water quality and flow data. While the Rio Tinto area is recognized as the major source, available data indicate that some copper loading is coming from other sources in the watershed. Therefore, a gross load allocation (LA) that accounts for all these sources has been set and is represented by the following equation:

$$\text{Load Allocation (lbs/day)} = \text{TMDL (lbs/day)} \times 0.90 \qquad \text{(Eq. 9)}$$

In Equation 9, a Margin of Safety (MOS) of 10% has been selected to account for inaccuracies in flow measurements.

The TMDL is intended to reflect adequate water quality needs across the entire range of flows rather than at a single flow, i.e. average flow. This has been accomplished through the use of the above equations whereby seasonal affects and critical conditions can be considered. It must be noted that the TMDLs/LAs calculated from these equations are not in effect during extreme low or high flows (see Table 5). Based upon estimated average annual flows and average hardness levels, average annual TMDLs/LAs for dissolved and total cadmium have been calculated for Mill Creek (Table 17).

Table 17. Average Annual Dissolved and Total Copper TMDLs/LAs

Stream/ Location	Average Annual Flow (cfs)	Dissolved Copper				Total Copper		
		Average Hardness (as calcium carbonate, mg/l)	Target (mg/l)	TMDL (pounds/ day)	LA (pounds/ day)	Target (mg/l)	TMDL (pounds/ day)	LA (pounds/ day)
Mill Creek – at mouth	4.1	240	0.021	0.46	0.42	0.2	4.42	3.98
EF Owyhee – at Duck Valley Indian Reservation Boundary	114.6	100	0.010	6.18	5.56		123.5	111.2

In some instances, TMDL reports present estimates of load reductions needed for compliance with the load allocations. However, this is not plausible for this TMDL. There are insufficient data to accurately calculate historic loads and associated load reductions. However it can be stated that for TMDL compliance, load reductions are needed such that actual loads are at or below the Load Allocations (from Equation 9) at least 90% of the time (for total copper) or are not exceeded more than once in a three year period (for dissolved copper)[6]. In the absence of flow data, the TMDL is considered to be complied with when the total copper levels are below the target at least 90% of the time, or when the dissolved copper levels exceed the target no more than once in a three year period.

3.2.5 ***Future Needs:*** Following are future needs that have been identified for the phased copper TMDL and related activities:

- The total copper water quality standard for irrigation is over 30 years old and needs to be evaluated. However, Nevada does not have the resources to undertake such a task and in these cases relies upon EPA to provide updated guidance for these standards. Unfortunately, these types of standards are not high on EPA's priority list for revisions. Any update of this standard is not currently part of NDEP's 5-year plan.

- Nevada's current standards for dissolved copper are outdated and need to be revised. The new equations developed by EPA (2002) result in 1-hour and 96-hour dissolved copper standard which are approximately 10% lower than the current equations in NAC 445A.144. NDEP plans to review these standards and seek revisions during State Fiscal Year 2005.

[6] As described in Nevada's 2002 303(d) List, waters are identified as impaired when the water quality standards are exceeded in more than 10% of the samples. For dissolved metals, waters are identified as impaired when the standards are exceeded more than once in any three-year period.

3.3 *Dissolved Oxygen TMDL*

3.3.1 ***Problem Statement:*** Table 18 summarizes dissolved oxygen data as collected by NDEP and RTWG and show the frequency of the dissolved oxygen concentration occurring below the water quality standard. Mill Creek was included on the 2002 303(d) List for dissolved oxygen impairment based upon NDEP grab sample data. It must be noted that all NDEP grab sample data were collected during the afternoon hours when dissolved oxygen levels are at or near a high for the day. Dissolved oxygen concentration fluctuates throughout the day, with minimum values generally occurring near sunrise and maximum values occurring in the afternoon. With this in mind, it is likely that the actual minimum dissolved oxygen levels that occur in the system are lower than the NDEP data would indicate.

Table 18. NDEP and RTWG Dissolved Oxygen Water Quality Standards and Historic Data for Mill Creek (mg/l)

Parameter	Above Rio Tinto Site (SW-1)	Below Rio Tinto Site (SW-2)	Below Rio Tinto Site (E14)
Period of Record	1995-2003	1995-2003	1997-2003
No. of Samples	48	57	16
No. of Samples (adjusted for extreme flows)	46	51	15
Standard = 6.00 mg/l: NAC 445A.223			
% of Samples Below Standard	2%	6%	27%
Average	9.9	9.2	8.9
Median	9.6	9.1	7.7
Minimum	3.2	2.7	5.3
Maximum	17.2	18.1	18.8

As shown in Table 18, the RTWG data at Site SW-2 show a less frequent exceedance of the standard than the NDEP data. One reason for this is the differing sampling frequencies used by NDEP and RTWG. NDEP samples E14 three times a year with one of those sampling days falling during lower flow periods (and lower DO periods) in the late summer or early fall. Site SW-2 has been sampled more frequently (about monthly) thereby increasing the number of samples during higher flows and dissolved oxygen levels.

Figure 5 presents detailed Mill Creek dissolved oxygen levels as measured by continuous monitoring probes from the Shoshone-Paiute Tribes. These plots show that dissolved oxygen levels below the water quality standard have occurred at various times, but low flow periods combined with higher air temperature periods appear to be the most critical. Some of the measured low dissolved oxygen periods may have occurred during extreme low flows when the water quality standards are not applicable.

3.3.2 ***Source Analysis:*** There are several factors which may contribute to lower dissolved oxygen levels in Mill Creek, including algal growth (supported by nutrient loads), decomposition of organic matter in the water column and within the sediments, oxidization of metals from acid mine drainage, temperature, and low streamflow. The existence of "yellowboy" deposits (iron oxide and sulfate deposits from acid mine water) within the stream substrate indicate the occurrence of iron oxidation, which can lower dissolved oxygen levels.

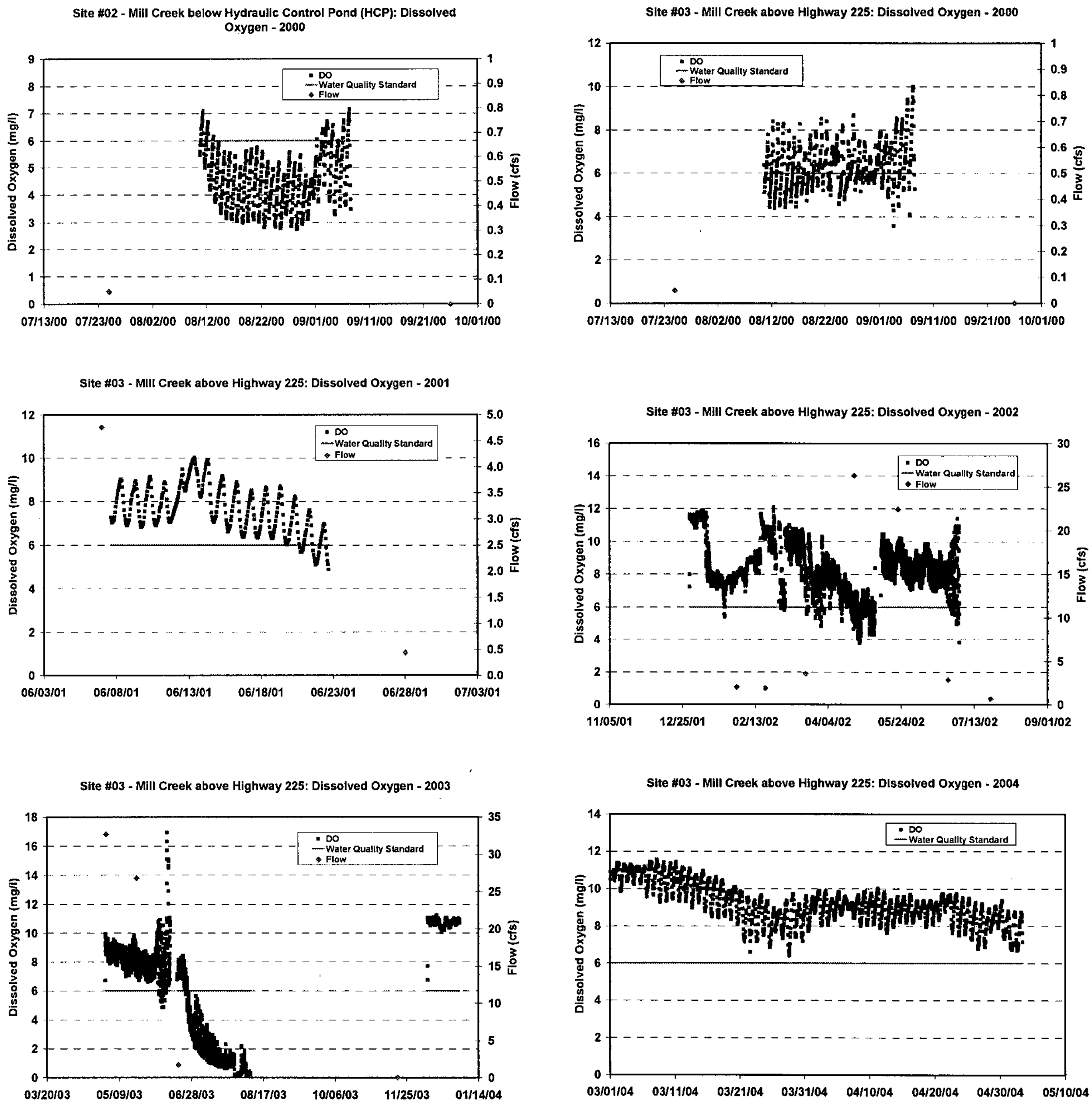

Figure 5. Dissolved Oxygen Data Collected on Mill Creek by Shoshone-Paiute Tribes and EPA

3.3.3 Target Analysis: As discussed earlier, NAC 445A.223 sets 6 mg/l as the minimum dissolved oxygen levels for the East Fork Owyhee River and its tributaries (Mill Creek). Based upon EPA recommendations, the standard has been set for the protection of a variety of aquatic life during their different life stages. Like terrestrial animals, fish and other aquatic organisms need oxygen to live. With dissolved oxygen levels below the standard, aquatic life production begins to be affected with mortality at the lower levels. Therefore for the purposes of this TMDL, the dissolved oxygen target has been set at 6 mg/l.

3.3.4 Pollutant Load Capacity and Allocation: Unlike most other chemical standards which have a maximum allowable level, dissolved oxygen standards represent a minimum value. Also, while a given chemical impairment is usually due to a loading of that same chemical, a dissolved oxygen impairment is usually due to loadings of other constituents (acid mine drainage, nutrients, organic matter) or other physical factors (streamflow, temperature). With these factors in mind, the dissolved oxygen target can only be met through reduced loads in acid mine drainage, nutrients, organic matter, etc. Currently, there is insufficient information available to determine the maximum allowable loads of metals, nutrients, etc. necessary to meet the dissolved oxygen target. Therefore for the dissolved oxygen TMDL, compliance is assumed to occur when the TMDLs for cadmium, copper, iron and total phosphorus are met, or when the dissolved oxygen target is met at least 90% of the time[7]. It must be noted that the TMDL is not in effect during extreme low or high flows (see Table 5).

3.3.5 Future Needs: Following are future needs that have been identified for the dissolved oxygen TMDL and related activities:

- Mill Creek was initially listed for dissolved oxygen impairment based upon grab sample data collected only 3 times a year from 1997 – 2001. Furthermore, all grab sample data collected during this five-year monitoring period were collected during the afternoon hours. Although dissolved oxygen concentrations fluctuate throughout the day, minimum values generally occurring near sunrise and maximum values occurring in the afternoon. With this in mind, the possibility exists that the few historic grab samples collected only captured the extreme daily highs rather than the critical daily lows. As discussed above, the Shoshone-Paiute Tribes have undertaken some continuous dissolved oxygen monitoring on Mill Creek. However, concurrent flow data would be helpful to determine whether or not the extreme conditions in Table 5 are being exceeded.

- As a single value standard, the current dissolved oxygen standard stated in NAC 445A.222 and NAC445A.223 is outdated. Current EPA guidance suggests dissolved oxygen criteria much more involved, including thresholds for 1-day minimums, 7-day mean minimums, 7-day means and 30-day means. NDEP intends to consider revision of the existing regulations into a format similar to the current EPA guidance, which includes duration needs. However at this time, such a revision effort is not part of NDEP's 5-year plan and has not yet been scheduled.

- The potential impacts of past and current activities at the Rio Tinto mine site on dissolved oxygen impairment in Mill Creek are not easily understood, due to the complex chemical and physical relationships that exist. Improved understanding of the relationships between dissolved oxygen, acid mine drainage, and the nutrients would be helpful for subsequent revisions of the TMDL.

[7] As described in Nevada's 2002 303(d) List, waters are identified as impaired when the water quality standards are exceeded in more than 10% of the samples.

3.4 Iron (Total)

3.4.1 Problem Statement: Tables 19 and 20 summarize total iron data as collected by NDEP and RTWG and show the frequency of exceedence of the water quality standard. By far the highest iron levels are occurring in Mill Creek. The data show that exceedences of the total recoverable iron beneficial use standard occur throughout the year. Significant exceedences often occur during the spring run-off period and late summer. Included in the data for Station E4 (East Fork Owyhee River above Mill Creek) is an abnormally high iron concentration of 23.40 mg/l (March 24, 1998). With the next highest E4 concentration at 1.33 mg/l, the 23.40 value needs to be considered suspect.

Based upon NDEP's data for 1997-2001, Mill Creek and the East Fork Owyhee River (above Mill Creek) were included on the 2002 303(d) List for total iron. The lower reach of the East Fork Owyhee River (below Mill Creek) was not included on the List due to an oversight. Based upon a review of the available data, it is expected that the lower reach will be added to the updated 2004 303(d) List for total iron.

Table 19. NDEP and RTWG Total Iron Water Quality Standards and Historic Data for East Fork Owyhee River (mg/l)

Parameter	Below Wild Horse Reservoir (E12)	Above Mill Creek (E4)	Above Mill Creek (SW-3)	Below Mill Creek (SW-4)	Below Mill Creek (E15)	At Duck Valley Indian Reservation Boundary (E16)
Period of Record	1996-2003	1979; 1988-2003	1995-2003	1995-2003	2000-03	2000-03
No. of Samples	17	29	59	61	9	9
No. of Samples (adjusted for extreme flows)	14	29	59	61	9	9
Standard = 1.0 mg/l: NAC 445A.144 Standards For Toxic Materials Applicable To Designated Waters – for Aquatic Life						
% Samples Exceeding Standard	0%	17%	22%	57%	33%	33%
Average	0.626	1.369	0.910	2.010	0.992	0.922
Median	0.420	0.470	0.510	1.350	0.490	0.470
Minimum	0.140	0.160	0.160	0.20	0.320	0.170
Maximum	3.190	23.400	12.000	18.00	2.280	2.090

3.4.2 Source Analysis: Natural and man-caused activities have contributed to the iron impairment of Mill Creek and the East Fork Owyhee River. Iron is a fairly common rock and soil constituent found in Nevada and it is not uncommon for waterbodies throughout the state to exhibit high concentrations of iron, primarily the result of natural run-off and seepage. NDEP and RTWG data show that iron standard exceedances are occurring throughout most of the study area.

The Rio Tinto area contribution is considered to be a significant source in the Mill Creek drainage. For the days RTWG sampled SW-1 and SW-2, about 71% (dissolved) and 56% (total) of the iron loading came from the watershed between SW-1 and SW-2 (Table 21). The remaining loads came from other sources throughout the watershed above Rio Tinto.

Table 20. NDEP and RTWG Total Iron Water Quality Standards and Historic Data for Mill Creek (mg/l)

Parameter	Above Rio Tinto Site (SW-1)	Below Rio Tinto Site (SW-2)	Below Rio Tinto Site (E14)
Period of Record	1995-2003	1995-2003	1997-2003
No. of Samples	44	54	15
No. of Samples (adjusted for extreme flows)	41	48	14
Standard = 1.0 mg/l: NAC 445A.144 Standards For Toxic Materials Applicable To Designated Waters – for Aquatic Life			
% Samples Exceeding Standard	21%	100%	100%
Average	0.850	15.300	20.344
Median	0.160	11.050	9.200
Minimum	0.020	0.120	1.560
Maximum	10.90	70.80	74.200

Table 21. Average Mill Creek Iron Loads for Days Sampled by RTWG (pounds per day)

Parameter	Above Rio Tinto Site (SW-1)	Below Rio Tinto Site (SW-2)
Dissolved iron	20.5	71.5
Total iron	160.8	362.5

Notes:
1. For samples reported as "Below Detection Limit", levels were assumed to be ½ of the detection limit.
2. Only days with flows greater than zero were included in calculations.
3. Information is provided to show the relative differences in loads between SW-1 and SW-2 and is NOT intended to provide an estimate of average annual loading at these locations.

3.4.3 ***Target Analysis:*** As discussed earlier, NAC 445A.144 sets 1,000 µg/l as the allowable total recoverable iron concentrations in Mill Creek and East Fork Owyhee River. This standard has been set at a certain level as needed to ensure continued support of the associated beneficial use, being aquatic life.

Nevada's iron standard was taken from EPA's 1976 publication – "Quality Criteria for Water", also referred to as the Red Book. According to the Red Book, the main problems associated with elevated iron levels include toxicity to fish and macroinvertebrates; and iron precipitates covering stream bottoms thereby destroying bottom-dwelling invertebrates, plants or incubating fish eggs. For the purposes of this TMDL, the total iron target has been set at the iron water quality standard of 1,000 µg/l for the 3 reaches in question: 1) EF Owyhee River above Mill Creek; 2) EF Owyhee River below Mill Creek; and 3) Mill Creek.

3.4.4 Pollutant Load Capacity and Allocation: The total iron Load Capacity or TMDL for Mill Creek and East Fork Owyhee River (for any given flow) is represented by the following equation:

Total iron TMDL (lbs/day) = Water Quality Target x Flow x 5.39 (Eq. 10)

Where:

Water Quality Target = 1 mg/l
Flow = streamflow, cubic feet per second
5.39 = conversion factor (converts equation results to pounds per day)

As the total iron standard is applicable throughout Mill Creek and East Fork Owyhee River (between Wild Horse Reservoir and the Duck Valley Indian Reservation), this TMDL equation can be applied to any site on these streams which has concurrent water quality and flow data. It is recognized that iron loading is coming from a variety of sources throughout the watershed. Therefore, a gross load allocation that accounts for all these sources has been set and is represented by the following equation:

Load Allocation (lbs/day) = TMDL (lbs/day) x 0.90 (Eq. 11)

A Margin of Safety (MOS) of 10% has been selected to account for inaccuracies in flow measurements.

The TMDL is intended to reflect adequate water quality needs across the entire range of flows rather than at a single flow, i.e. average flow. This has been accomplished through the use of the above equations whereby seasonal affects and critical conditions can be considered. It must be noted that the TMDLs/LAs calculated from these equations are not in effect during extreme low or high flows (see Table 5). Based upon estimated average annual flows, average annual TMDLs/LAs for total iron at various locations have been calculated (Table 22).

Table 22. Average Annual Total Iron TMDLs/LAs

Stream	Location	Average Annual Flow (cfs)	Total Iron TMDL (pounds/day)	Total Iron LA (pounds/day)
EF Owyhee River	Above Mill Creek	84.3	454.3	408.9
	At east boundary of Duck Valley Indian Reservation	114.6	617.7	555.9
Mill Creek	At confluence with EF Owyhee River	4.1	22.1	19.9

In some instances, TMDL reports present estimates of load reductions needed for compliance with the load allocations. However, this is not plausible for the East Fork Owyhee River and Mill Creek TMDL. There are insufficient data to accurately calculate historic loads and associated load reductions. However it can be stated that for TMDL compliance, load reductions are needed such that actual loads are at or below the Load Allocation (from Equation 11) at least 90% of the time[8]. In the absence of flow data, the TMDL is considered to be complied with when the total iron levels are below the target (1 mg/l) at least 90% of the time.

[8] As described in Nevada's 2002 303(d) List, waters are identified as impaired when the water quality standards are exceeded in more than 10% of the samples.

3.4.5 ***Future Needs:*** Following are future needs identified for the phased iron TMDL and related activities

- As stated earlier, Mill Creek and EF Owyhee iron loadings can be attributed to human-caused sources and natural sources within the watershed. It has been suggested that additional work is needed to better identify and quantify these various iron sources, differentiating between natural and human-caused sources. However before significant resources are spent on better characterizing iron sources, revision of the iron standard should be considered. As discussed above, Nevada's total iron water quality criteria was taken from EPA's Red Book. Upon closer examination, it becomes obvious that the Red Book criteria of 1.0 mg/l was based upon minimal information and its appropriateness needs to be questioned. In more recent years, EPA has been following a rather rigorous analysis in setting criteria for toxics. This same approach needs to be taken in revising the iron criteria. However, Nevada lacks the resources for such an undertaking and is relying on EPA to develop updated iron criteria. Other states are also recognizing the need for more appropriate iron criteria. In fact, Ohio EPA recently deleted their iron aquatic life standard of 1 mg/l. Based upon the presence of healthy aquatic populations in waters exceeding the 1 mg/l level, Ohio EPA concluded that this standard was not appropriate (Vorys, Sater, Seymour and Pease LLP, 2003). Until updated EPA guidance are made available, NDEP will be unable to seek any revisions to the iron standard.

3.5 pH TMDL

3.5.1 ***Problem Statement:*** Table 23 summarizes pH data collected by NDEP and RTWG and shows frequency of exceedances of the water quality standard for Mill Creek. A majority of the pH exceedances occurred in the late summer and fall during low flow periods.

Table 23. NDEP and RTWG pH Water Quality Standards and Historic Data for Mill Creek

Parameter	Above Rio Tinto Site (SW-1)	Below Rio Tinto Site (SW-2)	Below Rio Tinto Site (E14)
Period of Record	1995-2003	1995-2003	1997-2003
No. of Samples	44	54	17
No. of Samples (adjusted for extreme flows)	42	48	16
Standard = between 6.5 and 9.0: NAC 445A .223			
% of Samples Deviating From Standards	5%	48%	31%
Average	7.1	6.1	6.2
Median	7.0	6.4	7.4
Minimum	6.0	3.4	3.0
Maximum	8.3	8.0	8.3

Based upon NDEP's data, Mill Creek was included on the 2002 303(d) List. None of the East Fork Owyhee River data compiled indicated sufficient pH standard exceedances to justify 303(d) Listing.

3.5.2 ***Source Analysis:*** The Rio Tinto Mine area has long been identified as a significant contributor to the pH impairment of Mill Creek. Significant concentrations of sulfide minerals are found throughout the Mountain City-Pattsville-Owyhee area, in addition to the Rio Tinto site. The presence of these minerals in the presence of sufficient water and oxygen has a significant affect on pH and the generation of acid mine waters. Note that the generation of acid mine waters is extremely complex and is dependent on a variety of natural factors such as precipitation, run-off, temperature, surface flow and groundwater flow. In addition, chemical and physical factors such as pH, minerals/metals present, oxygen availability, bacteria present, surface chemistry and geological setting impact and contribute to the generation of acid mine waters.

3.5.3 ***Target Analysis:*** As discussed earlier, NAC 445A sets 6.5 to 9 as the allowable pH range for the East Fork Owyhee River and its tributaries (Mill Creek). Based upon EPA recommendations (EPA, 1986), the standard has been set for the protection of a variety of aquatic life forms during their different life stages. Research has shown that pH levels outside this range can impact vital life functions. Therefore for the purposes of this TMDL, the pH target has been set at 6.5 to 9 for Mill Creek.

3.5.4 Pollutant Load Capacity and Allocation: Unlike most other chemical standards which have a maximum allowable level, pH standards represent both a minimum and maximum value. Also, pH standards are not in concentration units (mg/l) complicating load capacity determination. 40 CFR § 130.2(i) provides flexibility in how TMDLs can be presented and suggests that they may be expressed in terms of "mass per time, toxicity, or other appropriate measure." For this pH TMDL, it has been determined that the appropriate measure for the allocation should be in terms of pH units. Therefore, the gross load allocation requires that the pH of water within Mill Creek shall be no less than 6.5 and no more than 9.0, under all flow regimes (except for extreme low flow periods (see Table 5) as provided in NAC 445A.121(8)).

No explicit margin of safety is needed for this load allocation as it is directly related to the water quality standard/target. Also, the TMDL is intended to reflect adequate water quality needs across the entire range of flows rather than at a single flow, i.e. average flow. This has been accomplished by requiring compliance with the pH standard/target under all flow regimes (except for extreme low and high flow periods). In general, the TMDL is considered to be complied with when the Mill Creek pH levels are between 6.5 and 9.0 at least 90% of the time[9].

3.5.5 ***Future Needs:*** Following are future needs identified for the phased pH TMDL and related activities:

- It may be that the remediation activities needed to comply with the metals TMDLs (cadmium, copper and iron) will also result in compliance with the pH standard. Additional work is needed to better under this relationship for subsequent phases of this TMDL.

3.6 ***Phosphorus (Total) TMDL***

3.6.1 ***Problem Statement:*** Tables 24 and 25 summarize total phosphorus data as collected by NDEP, RTWG and the Shoshone-Paiute Tribes and show frequency of exceedence of the water quality standard. Based upon NDEP's data for 1997-2001, Mill Creek and the East Fork Owyhee River were included on the 2002 303(d) List. The data show that the phosphorus standard is frequently exceeded throughout the East Fork Owyhee River and Mill Creek system with exceedances often occurring during the spring and summer months, however significant exceedences have also been documented during the winter months.

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[9] As described in Nevada's 2002 303(d) List, waters are identified as impaired when the water quality standards are exceeded in more than 10% of the samples.

Table 24. NDEP, RTWG and Tribes Total Phosphorus Water Quality Standards and Historic Data for East Fork Owyhee River (mg/l)

Parameter	Below Wild Horse Reservoir (E12)	Above Mill Creek (E4)	Above Mill Creek (SW-3)	Below Mill Creek (SW-4)	Below Mill Creek (E15)	Near Duck Valley Indian Reservation Boundary (E16)	At South Boundary of Duck Valley Indian Reservation (DV0100)
Period of Record	1996-2003	1968-2003	1995-2003	1995-2003	2000-03	2000-03	1999-03
No. of Samples	23	59	59	60	12	12	15
No. of Samples (adjusted for extreme flows)	20	59	59	60	12	12	15
Standard = 0.10 mg/l: NAC 445A.222 & NAC 445A.223							
% Samples Exceeding Standard	70%	56%	27%	27%	67%	67%	60%
Average	0.14	0.12	0.08	0.07	0.11	0.12	0.11
Median	0.13	0.10	0.06	0.07	0.11	0.11	0.11
Minimum	0.02	0.01	0.01	0.01	0.05	0.05	0.03
Maximum	0.33	0.43	0.57	0.26	0.20	0.20	0.23

Table 25. NDEP and RTWG Total Phosphorus Water Quality Standards and Historic Data for Mill Creek (mg/l)

Parameter	Above Rio Tinto Site (SW-1)	Below Rio Tinto Site (SW-2)	Below Rio Tinto Site (E14)
Period of Record	1995-2003	1995-2003	1997-2003
No. of Samples	43	53	17
No. of Samples (adjusted for extreme flows)	41	47	16
Standard = 0.10 mg/l: NAC 445A.222 & NAC 445A.223			
% Samples Exceeding Standard	7%	13%	31%
Average	0.05	0.05	0.11
Median	0.03	0.03	0.07
Minimum	0.01	0.01	0.00
Maximum	0.28	0.49	0.40

3.6.2 Source Analysis: The phosphorus sources within the EF Owyhee River and Mill Creek watersheds are believed to be varied and largely due to the naturally high phosphorus levels in Nevada soils. Phosphorus loads may be originating from watershed and streambank erosion, occurring naturally and/or as the result of land use practices (irrigation, grazing, recreation, mining). However, identifying the exact sources and pathways of phosphorus impairment for the Creek and River is difficult at this time due to lack of detailed data. RTWG data for SW-1 and SW-2 show no significant increase in total phosphorus loads coming from the Rio Tinto Mine area.

3.6.3 ***Target Analysis:*** As discussed earlier, NAC 445A sets 0.1 mg/l as the allowable total phosphorus concentrations in the East Fork Owyhee River and Mill Creek. This standard has been set at a certain level as needed to ensure continued support of the associated beneficial use, being aquatic life. Based upon EPA recommendations (1986), the total phosphorus standard was set to control eutrophication in streams and lakes. Algal growths impart undesirable tastes and odors, interfere with recreational values and alter the chemistry of the water, including dissolved oxygen levels. Therefore for purposes of this TMDL, the total phosphorus target has been set at 0.1 mg/l for the 3 reaches in question: 1) EF Owyhee River above Mill Creek; 2) EF Owyhee River below Mill Creek; and 3) Mill Creek.

3.6.4 ***Pollutant Load Capacity and Allocation:*** The total phosphorus Load Capacity or TMDL for Mill Creek and East Fork Owyhee River (for any given flow) is represented by the following equation:

Total phosphorus TMDL (lbs/day) = Water Quality Target x Flow x 5.39 (Eq. 12)

Where:

Water Quality Target = 0.1 mg/l
Flow = streamflow, cubic feet per second
5.39 = conversion factor (converts equation results to pounds per day)

As the total phosphorus standard is applicable throughout Mill Creek and the East Fork Owyhee River (above Duck Valley Indian Reservation), this TMDL equation can be applied to any site on these streams which has concurrent water quality and flow data. It is recognized that the phosphorus loading is coming from nonpoint sources throughout the watershed. Therefore, a gross load allocation that accounts for all these sources has been set and is represented by the following equation:

Load Allocation (lbs/day) = TMDL (lbs/day) (Eq. 13)

In Equation 11, a Margin of Safety (MOS) of 10% has been selected selected to account for inaccuracies in flow measurements.

The TMDL is intended to reflect adequate water quality needs across the entire range of flows rather than at a single flow, i.e. average flow. This has been accomplished through the use of the above equations whereby seasonal affects and critical conditions can be considered. It must be noted that the TMDLs/LAs calculated from these equations are not in effect during extreme low or high flows (see Table 5). Based upon estimated average annual flows, average annual TMDLs/LAs for total phosphorus have been calculated using the above equations (Table 26).

Table 26. Average Annual Total Phosphorus TMDLs/LAs

Stream	Location	Average Annual Flow (cfs)	Total Phosphorus TMDL (pounds//day)	Total Phosphorus LA (pounds/day)
EF Owyhee River	Below Wild Horse Reservoir	42.8	23.1	20.8
	Above Mill Creek	84.3	45.4	40.9
	At east boundary of Duck Valley Indian Reservation	114.6	61.8	55.6
Mill Creek	At confluence with EF Owyhee River	4.1	2.21	1.99

In some instances, TMDL reports present estimates of load reductions needed for compliance with the load allocations. However, this is not plausible for the East Fork Owyhee River and Mill Creek TMDL. There are insufficient data to accurately calculate historic loads and associated load reductions. However it can be stated that for TMDL compliance, load reductions are needed such that actual loads are at or below the Load Allocation (from Equation 13) at least 90% of the time[10]. In the absence of flow data, the TMDL is considered to be complied with when the total phosphorus levels are below the target (0.1 mg/l) at least 90% of the time.

3.6.5 Future Needs: Following are future needs that have been identified for the phased phosphorus TMDL and related activities:

- Little is known about the specific phosphorus sources within the watershed. As stated earlier, potential phosphorus sources include natural erosion in the watershed and the stream channel, and other land use practices. A source assessment may be needed to characterize (location, amount, timing) the various sources within the watershed. However before a large amount of resources are devoted to developing more complex TMDLs and control strategies, it is advisable to evaluate the suitability of the existing water quality standards for total phosphorus and other nutrients. The standard of 0.1 mg/l annual average applies across much of the state and is based on recommendations made in the Gold Book. These recommendations are not strongly supported in the Gold Book and are not identified as criteria, but rather as a "desired goal for the prevention of plant nuisances". Given the native soil conditions in the Great Basin and the topography that exists over much of Nevada, the suitability of the total phosphorus water quality standard must be questioned. It is clear that additional research is needed on the role of total phosphorus in eutrophication. Studies performed on the Truckee River and Pyramid Lake show that, in fact, nitrogen rather than phosphorus is the limiting nutrient.

  Again, NDEP is relying heavily on EPA for assistance in the development of more appropriate nutrient criteria. Currently, EPA Region IX is undertaking a nutrient criteria study which will hopefully provide states with some guidance for improved nutrient standards. It is expected that interim products from this study over the next couple years will provide some helpful information for NDEP to consider in potential nutrient criteria revisions. However, a time schedule for any criteria revision is not possible until more information is developed by this EPA study.

3.7 Temperature

3.7.1 Problem Statement: Tables 27 and 28 summarize temperature data as collected by NDEP, RTWG and the Tribes, and show frequency of exceedance of the seasonal temperature standards. Evaluation of NDEP and RTWG data, shows exceedances of the seasonal temperature standards occurring throughout the year and throughout the entire flow range. Based upon the NDEP data, Mill Creek and East Fork Owyhee River (above Mill Creek) were included on the 2002 303(d) List for temperature. The East Fork Owyhee River below Mill Creek was not included on the List due to an oversight. Based upon a review of the available data, it is expected that the East Fork Owyhee River below Mill Creek will be added to the 2004 303(d) List for temperature. It is interesting to note that exceedances at the Tribes' Site No. DV0100 were less frequent than at the nearby NDEP Site E-16. The main cause for this difference can be attributed to the dissimilar sampling times. While NDEP tends to sample Site E-16 in the midafternoon when temperatures are expected to be higher, much of the Tribes' sampling occurs around noon and earlier.

[10] As described in Nevada's 2002 303(d) List, waters are identified as impaired when the water quality standards are exceeded in more than 10% of the samples.

Table 27. NDEP, RTWG and Tribes Temperature Water Quality Standards and Historic Data for East Fork Owyhee River (°C)

Parameter	Below Wild Horse Reservoir (E12)	Above Mill Creek (E4)	Above Mill Creek (SW-3)	Below Mill Creek (SW-4)	Below Mill Creek (E15)	Near Duck Valley Indian Reservation Boundary (E16)	At South Boundary of Duck Valley Indian Reservation (DV0100)
Period of Record	1996-2003	1967-2003	1995-2003	1995-2003	2000-03	2000-03	1999-2003
Standard	NAC 445A .222 May – October (<21° C)			NAC 445A .223 May – October (<21° C)			
No. of Samples	15	46	35	35	8	8	10
No. of Samples (adjusted for extreme flows)	15	46	35	35	8	8	10
% of Samples Exceeding Standard	7%	15%	11%	9%	25%	25%	0%
Average	15.7	16.6	14.3	14.4	18.4	18.5	14.6
Median	15.7	17.8	14.6	14.8	18.6	19.1	16.2
Minimum	10.0	4.5	3.6	3.4	10.2	10.7	6.5
Maximum	25.3	25.0	24.9	24.9	24.0	21.5	18.3
Standard	NAC 445A .222 November – April (<7° C)			NAC 445A .223 November – April (<7° C)			
No. of Samples	7	16	32	32	4	4	5
No. of Samples (adjusted for extreme flows)	4	16	32	32	4	4	5
% of Samples Exceeding Standard	50%	38%	25%	22%	75%	50%	20%
Average	5.9	4.9	4.7	4.2	7.0	6.8	3.0
Median	6.0	5.2	4.6	3.6	7.5	7.2	2.0
Minimum	3.5	0.0	0.1	0.1	4.1	4.0	0.0
Maximum	7.8	8.9	14.3	13.6	9.0	8.9	7.4

Figure 6 presents detailed Mill Creek temperature data collected by the Shoshone-Paiute Tribes. These plots show that temperature levels have exceeded the water quality standard at various times of the year, not just summer. Some of the measured high temperature periods may have occurred during extreme low flows when the water quality standards are not applicable.

*3.7.2 **Source Analysis:*** Some key factors potentially affecting water temperatures in Mill Creek and EF Owyhee River include riparian vegetation, stream flow, climate. While climate is outside the sphere of human control, riparian conditions and streamflow can be affected by land use activities.

Additionally, a secondary contributor to temperature impairment could be the processes that generate acid mine waters. When sufficient water, oxygen and sulfide/metal tolerant bacteria (i.e. *Thiobacillius ferrooxidans, T. novellas* and *T. thioporus*) are available, sulfide minerals will preferentially oxidize and solubilize (dissolve), liberating heat (i.e. an exothermic reaction) and lowering pH in the process. This liberation of heat often results in localized water temperature increases (i.e. pockets). A rise in temperature by just a few degrees will significantly increase the rate of the oxidation and dissolution reactions, consequently decreasing pH even further (i.e. become more acidic), which in turn will dissolve

Table 28. NDEP and RTWG Temperature Water Quality Standards and Historic Data for Mill Creek (°C)

Parameter	Above Rio Tinto Site (SW-1)	Below Rio Tinto Site (SW-2)	Below Rio Tinto Site (E14)
Period of Record	1995-2003	1995-2003	1997-2003
Standard	NAC 445A .223 May – October (<21° C)		
No. of Samples	21	28	10
No. of Samples (adjusted for extreme flows)	20	23	9
% of Samples Exceeding Standard	10%	17%	56%
Average	14.9	15.1	21.2
Median	14.6	15.7	21.4
Minimum	5.2	2.3	12.9
Maximum	26.1	25.7	31.0
Standard	NAC 445A .223 November - April (<7° C)		
No. of Samples	27	31	6
No. of Samples (adjusted for extreme flows)	27	30	6
% of Samples Exceeding Standard	15%	27%	50%
Average	4.0	4.5	6.2
Median	4.4	4.6	6.6
Minimum	0.2	0.0	3.4
Maximum	13.8	13.1	8.8

those sulfides/metals which would not dissolve under slightly acidic conditions, generating even more heat and a temperature increase.

3.7.3 ***Target Analysis:*** As discussed earlier, NAC 445A sets the allowable water temperatures in the East Fork Owyhee River and Mill Creek. Based upon recommendations from the Nevada Department of Wildlife, these standards were set at levels needed to ensure continued support of the associated beneficial use, being aquatic life. The ultimate goal of this TMDL is to support these uses through compliance with the temperature standards shown below:

Temperature target (May – October) - <21° C
Temperature target (November – April) - <7° C

3.7.4 ***Pollutant Load Capacity and Allocation:*** 40 CFR § 130.2(i) provides flexibility in how TMDLs can be presented and suggests that they may be expressed in terms of "mass per time, toxicity, or other appropriate measure." For this temperature TMDL, it has been determined that the appropriate measure for the allocation should be in terms of degrees Celsius. While many temperature TMDLs throughout the country report the load allocations in terms of heat loading (calories per day, etc.), there is insufficient information to use this approach for Mill Creek and the EF Owyhee River. Therefore, the load allocation requires that the temperature of water within Mill Creek and the EF Owyhee River shall be no more than the temperature targets/standards, under all flow regimes (except for extreme low flow periods as provided in NAC 445A.121(8)) (see Table 5).

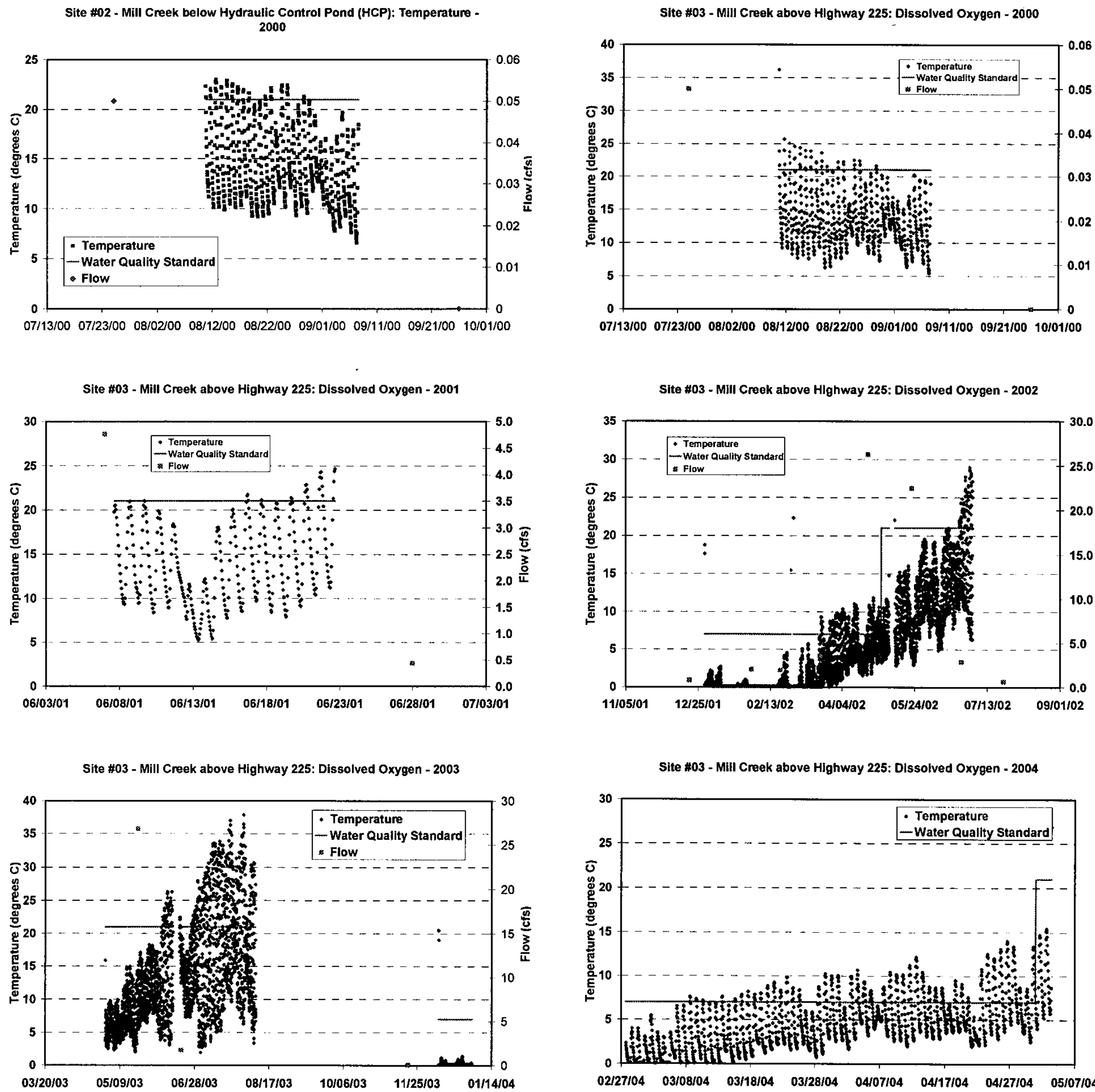

Figure 6. Temperature Data Collected on Mill Creek by Shoshone-Paiute Tribes and EPA

No explicit margin of safety is needed for this load allocation as it is expressed as the water quality standard/target. Also, the TMDL is intended to reflect adequate water quality needs across the entire range of flows rather than at a single flow, i.e. average flow. This has been accomplished by requiring compliance with the temperature standard/target under all flow regimes. In general, the TMDL is considered to be complied with when the Mill Creek and EF Owyhee River temperature levels are below the targets at least 90% of the time[11].

3.7.5 Future Needs: Following are future needs that have been identified for the phased temperature TMDL and related activities:

- Mill Creek and the East Fork Owyhee River were listed for temperature impairment based on spot temperature readings taken at various times of the day. More detailed monitoring is needed to better characterize the extent of the high temperatures throughout the day and their frequency. As discussed above, the Shoshone-Paiute Tribes have undertaken some continuous temperature monitoring on Mill Creek. However, concurrent flow data would be helpful to determine whether or not the extreme conditions in Table 5 are being exceeded.

- As stated earlier, many factors could be contributing to temperature impairment in Mill Creek and the East Fork Owyhee River. Because of the complex chemical-geological-biological relationships that exist, identifying actual sources and pathways of the impairment are difficult at this time. Future efforts are needed to improve understanding of the temperature relationships and heat loadings within the watershed.

- Additionally, temperature standards need to be added for Mill Creek and reviewed for East Fork Owyhee River. Mill Creek temperature standards should recognize the ephemeral nature of the stream. Current temperature standards are "single value" standards, without any consideration of duration. A more appropriate temperature standard would include thresholds for 7-day means, 7-day mean maximums, etc. In general, temperature standard revisions are not part of NDEP's 5-year plan and no time schedule has been set.

3.8 Total Suspended Solids and Turbidity

3.8.1 Problem Statement: Tables 29 through 32 summarize total suspended solids (TSS) and turbidity data as collected by NDEP and RTWG and show frequency of exceedence of the water quality standards. Exceedances of the TSS and turbidity standards occur throughout the study area, with the most frequent exceedances occurring in Mill Creek. The springtime is the most common period for elevated TSS and turbidity levels. Based upon NDEP's data, Mill Creek and the two reaches of the East Fork Owyhee River (from Wildhorse Reservoir to Mill Creek; and from Mill Creek to Duck Valley Indian Reservation) were included on the 2002 303(d) List for TSS and turbidity.

3.8.2 Source Analysis: Numerous potential sediment sources exist within the Mill Creek/EF Owyhee River watershed such as natural erosion in the watershed and the stream channel, and erosion from dirt roads, trails, mining activities, grazing, etc. RTWG data for SW-1 and SW-2 show no significant increase in total suspended loads coming from the Rio Tinto Mine area.

[11] As described in Nevada's 2002 303(d) List, waters are identified as impaired when the water quality standards are exceeded in more than 10% of the samples.

Table 29. NDEP and RTWG Total Suspended Solids Water Quality Standards and Historic Data for East Fork Owyhee River (mg/l)

Parameter	Below Wild Horse Reservoir (E12)	Above Mill Creek (E4)	Above Mill Creek (SW-3)	Below Mill Creek (SW-4)	Below Mill Creek (E15)	At Duck Valley Indian Reservation Boundary (E16)	At South Boundary of Duck Valley Indian Reservation (DV0100)
Period of Record	1996-2003	1980-2003	1995-2003	1995-2003	2000-03	2000-03	1999-2003
No. of Samples	23	39	58	61	12	12	15
No. of Samples (adjusted for extreme flows)	21	39	58	61	12	12	15
Standard = 25 mg/l: NAC 445A.222 & NAC 445A.223							
% Samples Exceeding Standard	5%	31%	12%	16%	25%	33%	0
Average	10.2	28.7	16.0	17.0	19.4	21.8	10.7
Median	7.0	14.0	8.0	8.0	14.0	11.5	10.0
Minimum	2	2	5	5	4	5	3.0
Maximum	54	332	260	174	66	85	24.0

Table 30. NDEP and RTWG Total Suspended Solids Water Quality Standards and Historic Data for Mill Creek (mg/l)

Parameter	Above Rio Tinto Site (SW-1)	Below Rio Tinto Site (SW-2)	Below Rio Tinto Site (E14)
Period of Record	1995-2003	1995-2003	1997-2003
No. of Samples	44	54	17
No. of Samples (adjusted for extreme flows)	42	48	16
Standard = 25 mg/l: NAC 445A.223			
% Samples Exceeding Standard	5%	60%	69%
Average	15.1	39.9	69.5
Median	5.0	34.0	48.0
Minimum	5	5	1
Maximum	236	186	318

3.8.3 ***Target Analysis*** : As discussed earlier, NAC 445A.222 and 445A.223 set 10 NTU and 25 mg/l as the water quality standards for turbidity and total suspended solids, respectively. Nevada's turbidity and TSS standards were taken from past water quality criteria publication (National Technical Advisory Committee, 1968; National Academy of Sciences, 1972). These standards have been set at a certain level as needed to ensure continued support of the associated beneficial use, being aquatic life. Turbidity and TSS can impact aquatic life in several ways: 1) settleable solids block stream bottoms gravels affecting macroinvertebrate and fish egg survival; 2) sediment can clog gills interfering with respiration; 3) sediment can be abrasive to gills; and 4) sediment can impair the ability of sight-feeding species (such as trout) to feed.

Table 31. NDEP and RTWG Turbidity Water Quality Standards and Historic Data for East Fork Owyhee River (NTU)

Parameter	Below Wild Horse Reservoir (E12)	Above Mill Creek (E4)	Above Mill Creek (SW-3)	Below Mill Creek (SW-4)	Below Mill Creek (E15)	At Duck Valley Indian Reservation Boundary (E16)	At South Boundary of Duck Valley Indian Reservation (DV0100)
Period of Record	1996-2003	1969-2003	1995-2003	1995-2003	2000-03	2000-03	1999-2003
No. of Samples	21	55	59	61	12	12	15
No. of Samples (adjusted for extreme flows)	18	55	59	61	12	12	15
Standard = 10 NTU: NAC 445A.222 & NAC 445A.223							
% Samples Exceeding Standard	17%	45%	27%	51%	50%	50%	33%
Average	8.5	14.2	11.2	16.3	12.5	13.1	7.6
Median	6.3	8.7	5.5	10.0	9.5	9.9	6.0
Minimum	2.4	1.0	1.3	2	3.2	1.7	1.5
Maximum	35	227	166	139	36	45	21

Table 32. NDEP and RTWG Turbidity Water Quality Standards and Historic Data for Mill Creek (NTU)

Parameter	Above Rio Tinto Site (SW-1)	Below Rio Tinto Site (SW-2)	Below Rio Tinto Site (E14)
Period of Record	1995-2003	1995-2003	1997-2003
No. of Samples	44	54	15
No. of Samples (adjusted for extreme flows)	42	48	14
Standard = 10 NTU: NAC 445A.222 & NAC 445A.223			
% Samples Exceeding Standard	26%	94%	93%
Average	10.6	61.2	96.6
Median	1.5	45.4	57.1
Minimum	0.2	0.3	2.0
Maximum	170	302	387

The turbidity standard of measurement (NTU) is unique in the fact that it is not directly amenable to any loading equation. Therefore, the use of TSS as a surrogate for turbidity was evaluated. Using a linear regression approach, relationships between turbidity and TSS were developed for the various monitoring stations at the lower limits of the 3 reaches in question: 1) EF Owyhee River above Mill Creek; 2) EF Owyhee River at Duck Valley Indian Reservation; and 3) Mill Creek. Of the NDEP and RTWG data examined, only EF Owyhee River above Mill Creek (E4, SW-3) and EF Owyhee River at east boundary of Duck Valley Indian Reservation (E16) locations yielded useful regression equations (correlation coefficient, $R^2 = 0.95$ for both):

EF Owyhee River above Mill Creek:

$$TSS\ (mg/l) = Turbidity\ (NTU) \times 1.494 \quad (Eq.\ 14)$$

For EF Owyhee River at Duck Valley Indian Reservation boundary:

$$TSS\ (mg/l) = Turbidity\ (NTU) \times 1.747 \quad (Eq.\ 15)$$

For Mill Creek, the correlation coefficient indicated a poor relationship ($R^2 = 0.15$). Based upon Equation 14, a turbidity level of 10 NTU at the EF Owyhee River above Mill Creek equates to a TSS level of 15 mg/l at the same location. For the EF Owyhee River at the Duck Valley Indian Reservation boundary, Equation 15 yields a TSS level of 17 mg/l. These TSS levels have been selected as the target needed to meet both the TSS and turbidity standards at this points. For Mill Creek, both turbidity and TSS targets are needed (Table 33).

Table 33. Turbidity and Total Suspended Solids Targets for East Fork Owyhee River and Mill Creek

Control Point	Turbidity Target	TSS Targets
EF Owyhee River above Mill Creek	TSS target of 15 mg/l needed to meet both the turbidity and the TSS standards	
EF Owyhee River at Duck Valley Indian Reservation Boundary	TSS target of 17 mg/l needed to meet both the turbidity and the TSS standards	
Mill Creek	10 NTU	25 mg/l

3.8.4 ***Pollutant Load Capacity and Allocation:*** The TSS Load Capacities or TMDLs for Mill Creek and EF Owyhee River (for any given flow) are represented by the following equation:

$$TSS\ TMDL\ (lbs/day) = Water\ Quality\ Target \times Flow \times 5.39 \quad (Eq.\ 16)$$

Where:

Water Quality Target:

EF Owyhee River above Mill Creek = 15 mg/l

EF Owyhee River at Duck Valley Indian Reservation boundary = 17 mg/l

Mill Creek = 25 mg/l

Flow = streamflow, cubic feet per second

5.39 = conversion factor (converts equation results to pounds per day)

As the TSS standard is applicable throughout Mill Creek, this TMDL equation (with the appropriate target) can be applied to any site on Mill Creek which has concurrent water quality and flow data. For the EF Owyhee River, this TMDL equation with the various targets is applicable only at the 2 specific control points: 1) EF Owyhee River above Mill Creek; and 2) EF Owyhee River at Duck Valley Indian Reservation boundary. It is recognized that major TSS loading is coming from a variety of nonpoint sources within the watersheds. Therefore, a gross load allocation that accounts for all these sources has been set and is represented by the following equation:

$$Load\ Allocation\ (lbs/day) = TMDL\ (lbs/day) \times Margin\ of\ Safety \quad (Eq.\ 17)$$

Where:

Margin of Safety:

EF Owyhee River = 0.80

Mill Creek = 0.90

As previously discussed, TMDLs are to include a margin of safety to account for uncertainties in meeting the water quality standards when the target and TMDL are met. A factor of 0.80 has been selected for EF Owyhee River to account for uncertainty in flow measurements and the relationship between TSS and turbidity. For Mill Creek, a factor of 0.90 has been selected to account for errors in flow measurement.

The TMDL is intended to reflect adequate water quality needs across the entire range of flows rather than at a single flow, i.e. average flow. This has been accomplished through the use of the above equations whereby seasonal effects and critical conditions can be considered. It must be noted that the TMDLs/LAs calculated from these equations are not in effect during extreme low or high flows (see Table 5). Based upon estimated average annual flows, average annual TMDLs/LAs for total suspended solids have been calculated using the above equations (Table 34).

Table 34. Average Annual Total Suspended Solids TMDLs/LAs

Stream	Location	Average Annual Flow (cfs)	Target (mg/l)	Total Suspended Solids TMDL (pounds//day)	Total Suspended Solids LA (pounds/day)
EF Owyhee River	Above Mill Creek	84.3	15	6,816	5,453
	At east boundary of Duck Valley Indian Reservation	114.6	17	10,501	8,401
Mill Creek	At confluence with EF Owyhee River	4.1	25	552	497

In some instances, TMDL reports present estimates of load reductions needed for compliance with the load allocations. However, this is not plausible for the Mill Creek and EF Owyhee River TSS TMDLs. There are insufficient data to accurately calculate historic loads and associated load reductions. However it can be stated that for TMDL compliance, load reductions are needed such that actual loads are at or below the Load Allocation (from Equation 14) at least 90% of the time[12]. In the absence of flow data, the TMDL is considered to be complied with when the TSS levels are below the targets (Table 23) at least 90% of the time.

As already presented, the turbidity target for the lower EF Owyhee River and Mill Creek can not be represented as a load. 40 CFR § 130.2(i) provides flexibility in how TMDLs can be presented and suggests that they may be expressed in terms of "mass per time, toxicity, or other appropriate measure." For the Mill Creek turbidity TMDL, it has been determined that the appropriate measure for the allocation should be in terms of turbidity units (NTUs). Therefore, the load allocation requires that the turbidity of water within Mill Creek and the EF Owyhee River (below Mill Creek) shall be no more than 10 NTUs under all flow regimes (except for extreme high flow periods as provided in NAC 445A.121(8)) (Table 5). For turbidity, the TMDL is considered to be complied with when the turbidity levels are below the targets (Table 23) at least 90% of the time.

3.8.5 Future Needs: Following are future needs identified for the phased TSS/turbidity TMDL and related activities:

- Little is known about the specific TSS and turbidity sources within the watershed. As stated

[12] As described in Nevada's 2002 303(d) List, waters are identified as impaired when the water quality standards are exceeded in more than 10% of the samples.

earlier, potential sediment sources in the watershed include natural erosion in the watershed and the stream channel, and erosion from dirt roads, trails, mining activities, grazing, etc. Additional work is needed to characterize (location, amount, timing) the various sources within the watershed, and separate out natural and human-caused sources.

- As additional data are collected, the linear regression relationships between TSS and turbidity can be revisited for subsequent TMDL revisions.

- The TSS and turbidity standards for waters throughout the state are based upon outdated national guidance and may not be appropriate for all waters. The shortcomings of sediment-related criteria throughout the nation has been recognized and EPA is developing a strategy for improved criteria (2003). NDEP lacks the resources to develop more appropriate criteria and is relying on EPA to provide updated criteria. Until such updated criteria are developed, Nevada will not be able to revise any TSS and turbidity standards.

3.9 Total Dissolved Solids

3.9.1 ***Problem Statement:*** Table 35 summarizes total dissolved solids (TDS) data as collected by NDEP and RTWG and show the frequency of the exceedence of the water quality standard. A majority of the elevated TDS concentrations occurred during low flow periods. Based upon NDEP data, Mill Creek was included on the 2002 303(d) List for TDS. The data did not indicate any TDS standard exceedances for the East Fork Owyhee River.

Table 35. NDEP and RTWG Total Dissolved Solids Water Quality Standards and Historic Data for Mill Creek (mg/l)

Parameter	Above Rio Tinto Site (SW-1)	Below Rio Tinto Site (SW-2)	Below Rio Tinto Site (E14)
Period of Record	1995-2003	1995-2003	1997-2003
No. of Samples	44	54	17
No. of Samples (adjusted for extreme flows)	42	48	16
Standard = 500 mg/l: NAC 445A.223			
% of Samples Below Standard	0%	15%	38%
Average	110	390	517
Median	110	260	300
Minimum	70	70	99
Maximum	180	3700	1231

3.9.2 ***Source Analysis:*** RTWG data for sites SW-1 and SW-2 show that TDS water quality standards are consistently met above the Rio Tinto Site, but that some exceedances occur below the site. While the Rio Tinto site contributes sufficiently high TDS waters to cause some standards exceedances during low flow periods, the overall TDS load (in pounds per day) coming from the site is smaller than the load coming from the upper Mill Creek watershed. For the days RTWG sampled SW-1 and SW-2, only about 18% of the TDS loading came from the watershed between SW-1 and SW-2 (Table 36). The remaining loads came from other sources throughout the watershed above Rio Tinto.

Table 36. Average Mill Creek TDS Loads for Days Sampled by RTWG (pounds per day)

Parameter	Above Rio Tinto Site (SW-1)	Below Rio Tinto Site (SW-2)
Total Dissolved Solids	5,900	7,200

Notes:
1. For samples reported as "Below Detection Limit", levels were assumed to be ½ of the detection limit.
2. Only days with flows greater than zero were included in calculations.
3. Information is provided to show the relative differences in loads between SW-1 and SW-2 and is NOT intended to provide an estimate of average annual loading at these locations.

3.9.3 Target Analysis As discussed earlier, NAC 445A sets 500 mg/l as the allowable TDS concentration in Mill Creek. This standard has been set at a certain level as needed to ensure continued support of the associated beneficial use, being municipal or domestic water supply. While Mill Creek is not currently used as a drinking water source, "municipal or domestic water supply" has been identified as one of its designated or potential beneficial uses. As such, these criteria still apply.

The TDS standard of 500 mg/l coincides with State Health's secondary standard (NAC 445A.455) for public water systems. While public water systems are not required to meet secondary standards, they are required to notify the public of secondary standard exceedances if other more suitable, economically feasible water supplies are available. As a secondary standard constituent, TDS is regulated because it is more of an aesthetic and operational concern rather than a health hazard. Elevated TDS levels may cause the water to be corrosive, salty or brackish taste, result in scale formation, and interfere and decrease efficiency of hot water heaters. Therefore for the purposes of this TMDL, the TDS target is set at 500 mg/l.

3.9.4 Pollutant Load Capacity and Allocation: The TDS Load Capacity or TMDL for Mill Creek (for any given flow) is represented by the following equation:

TMDL (lbs/day) = Water Quality Target x Flow x 5.39 (Eq. 18)

Where:

Water quality target = 500 mg/l
Flow = streamflow, cubic feet per second
5.39 = conversion factor (converts equation results to pounds per day)

As the TDS standard is applicable throughout the entire stream, this TMDL equation can be applied to any site on Mill Creek which has concurrent water quality and flow data. It is recognized that TDS loading is coming from various sources within the Rio Tinto Mine site area and the upstream watershed. Therefore, a gross load allocation that accounts for all these sources has been set and is represented by the following equation:

Load Allocation (lbs/day) = TMDL (lbs/day) x 0.90 (Eq. 19)

In Equation 19, a Margin of Safety (MOS) of 10% has been selected to account for inaccuracies in flow measurements.

The TMDL is intended to reflect adequate water quality needs across the entire range of flows rather than at a single flow, i.e. average flow. This has been accomplished through the use of the above equations whereby seasonal affects and critical conditions can be considered. It must be noted that the TMDLs/LAs calculated from these equations are not in effect during extreme low or high flows (see Table 5). Based upon estimated average annual flows, average annual TMDLs/LAs for total dissolved solids have been calculated using the above equations (Table 37).

Table 37. Average Annual Total Dissolved Solids TMDLs/LAs

Stream/Location	Average Annual Flow (cfs)	Target (mg/l)	TMDL (pounds/day)	LA (pounds/day)
Mill Creek – at mouth	4.1	500	11,050	9,945

In some instances, TMDL reports present estimates of load reductions needed for compliance with the load allocations. However, this is not plausible for the Mill Creek TMDL. There are insufficient data to accurately calculate historic loads and associated load reductions. However it can be stated that for TMDL compliance, load reductions are needed such that actual loads are at or below the Load Allocation (from Equation 19) at least 90% of the time[13]. In the absence of flow data, the TMDL is considered to be complied with when the TDS levels are below the target (500 mg/l) at least 90% of the time.

3.9.5 Future Needs: Following are future needs that have been identified for the phased TDS TMDL and related activities:

- There is insufficient information to accurately estimate TDS loads from the Rio Tinto area and the remainder of the watershed. Additional work is needed to quantify historic loading and load reductions. However, first the appropriateness of "municipal or domestic supply" as a beneficial use for Mill Creek needs to be examined. Mill Creek is not currently used as a municipal or domestic drinking water source nor is it likely to be in the future. BWQP may need to consider undertaking a Use Attainability Analysis (UAA) for this use on Mill Creek. At this time, a UAA for Mill Creek is not part of NDEP's 5-year plan and has not yet been scheduled.

[13] As described in Nevada's 2002 303(d) List, waters are identified as impaired when the water quality standards are exceeded in more than 10% of the samples.

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Appendix

Water Quality and Quantity Data at Selected Monitoring Stations

Table A-1: Selected Water Quality Data - NDEP Site E12: EF Owyhee River below Wild Horse Reservoir

Date	Sample Time	Flow (cfs) - Sta. 13174500	DO (mg/L)	Temperature (Degrees C) May-Oct	Temperature (Degrees C) Nov-Apr	pH (in field)	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Ortho P (mg/L)	Total P (mg/L)	Dissolved Cadmium (ug/L)	Total Cadmium (ug/L)	Dissolved Copper (ug/L)	Total Copper (ug/L)	Dissolved Iron (ug/L)	Total Iron (ug/L)	Hardness as $CaCO_3$ (mg/L)
3/26/1996	15:30	0.8	9.9		6.0	8.12	62	34	18.0	0.03	0.10		< 1		20		790	31
7/30/1996	14:15	126	7.9	15.1		8.29	134	10	5.2	0.04	0.11		< 1		< 5		260	73
9/24/1996	16:20	17	8.7	14.0		8.20	139	6	5.2	0.11	0.14		< 1		10		330	78
3/25/1997	15:45	120	11.6		3.5	7.93	129	6	6.8	0.07	0.10		< 1		10		420	73
7/8/1997	16:00	43	9.0	17.4		8.47	87	5	5.4	0.05	0.07		< 1		< 2		644	53
9/23/1997	15:20	74	7.9	17.7		8.79	104	5	4.8	0.21	0.28							
3/24/1998	15:30	0	11.7		4.8	7.68	71	54	35.0	0.05	0.18		< 1		4		3190	24
7/7/1998	15:50	28					133	10		0.06	0.03		< 1		4		394	67
9/22/1998	16:00	78	7.7	15.7		8.10	140	10		0.16	0.19							
3/23/1999	15:20	0.03	5.5		7.2	7.90	63	5	7.8	0.03	0.06	< 1	< 1	< 20	< 20	640	630	28
7/6/1999	16:16	83	9.4	13.2		8.17	118	4	9.1	0.06	0.08		< 1		10		500	71
9/21/1999	16:35	89	6.9	16.3		8.31	119	13	3.7	0.12	0.15							
3/21/2000		0.07																
7/11/2000	15:20	99	8.2	16.1		7.50	133	7	7.2	0.04	0.08	< 1	< 1	< 20	< 20	310	550	73
9/19/2000	12:30	21	8.8	17.2		8.51	125	7	4.6	0.12	0.14	< 1	< 1	< 20	< 20	290	530	78
4/3/2001	13:10	0.01	10.4		4.3	7.63	47	3	6.3	0.01	0.02	< 1	< 1	< 20	< 20	530	390	19
7/10/2001	15:40	41	8.0	14.8		8.10	147	5	4.0	0.11	0.13	< 2	< 2	< 20	< 20	240	360	81
9/18/2001	15:30	4.4	15.8	10.0		9.10	163	9	8.1	0.12	0.16	< 1	< 1	< 20	< 20	40	420	78
3/26/2002	13:40	0.1	9.6		7.8	8.50	67	2	2.4	0.01	0.02	< 5	< 1	< 20	< 20	190	180	22
7/9/2002	15:40	107	9.8	13.6		8.20	156	11	13.0	0.11	0.15	< 2	< 2	< 20	< 20	780	910	76
8/12/2002	12:30	71	10.0	17.6		8.06	145	6	4.8	0.23	0.26							
4/22/2003	14:05	0.1	7.8		7.8	7.76	61	10	7.2	0.01	0.04							
8/12/2003	15:00	0.1	4.5	25.3		8.70	162	5	2.7	0.22	0.31	< 2	< 2	< 20	< 20	20	140	90
10/14/2003	15:10		16.8	12.2		8.30	183	7	17.0	0.26	0.33							
Criteria			>6	<21	<7	>=6.5 <=9	<500	<25	<10	none	<0.1	Varies	<5	Varies	<200	none	<1000	none
No. of Samples			22	15	7	22	23	23	21		23	9	17	9	17		17	
No. of Samples (adjusted)			19	15	4	19	20	21	18		20	7	14	7	14		14	
No. of Exceedances			1	1	2	1	0	1	3		14	0	0	0	0		0	
% Exceedances			5%	7%	50%	5%	0%	5%	17%		70%	0%	0%	0%	0%		0%	
Average			9.4	15.7	5.9	8.2	116.9	10.2	8.5	0.10	0.14	BDL	BDL	BDL	BDL	338	626	
Median			8.9	15.7	6.0	8.2	129.0	7.0	6.3	0.07	0.13	BDL	BDL	BDL	BDL	290	420	
Minimum			4.5	10.0	3.5	7.5	47.0	2.0	2.4	0.01	0.02	BDL	BDL	BDL	BDL	20	140	
Maximum			16.8	25.3	7.8	9.1	183.0	54.0	35.0	0.26	0.33	BDL	BDL	BDL	20.0	780	3190	

Number of samples adjusted to account for extreme low flow periods
BDL = Below detection limit
Values less than detection limit assumed to meet water quality criteria (see NAC 445A.144)
= sample collected during period when flow < 7Q10 Low (0.1 cfs) - therefore, any noncompliance with standards are not included as an exceedance in the calculations
= water quality criteria exceeded

Table A-2: Selected Water Quality Data - NDEP Site E4: EF Owyhee River above Mill Creek

Date	Sample Time	Flow (cfs)	DO (mg/L)	Temperature (Degrees C)		pH (in field)	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Ortho P (mg/L)	Total P (mg/L)	Dissolved Cadmium (ug/L)	Total Cadmium (ug/L)	Dissolved Copper (ug/L)	Total Copper (ug/L)	Dissolved Iron (ug/L)	Total Iron (ug/L)	Hardness as $CaC0_3$ (mg/L)
				May-Oct	Nov-Apr													
6/20/1967	9:20		7.5	13.5						0.07								
7/11/1967	15:15		8.0							0.10								
8/1/1967	15:00		7.1	20.0						0.16								
8/22/1967	14:00		6.7	21.0						0.08								
11/20/1967	15:30		10.2		5.0					0.02								
1/23/1968	14:30		9.5		0.0					0.03								
7/9/1968	14:00		8.4	19.0							0.10							
8/26/1968	13:45		10.8	13.0						0.09	0.09							
11/13/1968			9.1		1.0					0.09	0.10							
4/2/1969	14:25		10.3		0.0				18	0.05	0.05							
4/2/1969	14:45								8									
7/30/1969	14:30		7.3	19.5					2	0.01	0.01							
8/26/1969	17:00		8.6	21.0					7	0.32	0.35							
12/8/1969	19:40		10.3		0.5				2	0.03	0.03							
8/11/1970	9:05		8.8	25.0					3	0.12	0.12							
5/24/1971	20:00		8.9	12.5					6	0.05	0.05							
8/30/1971	19:20		8.3	18.5					5	0.13	0.14							
6/27/1972	19:30		9.3	19.0					8	0.05	0.07							
11/29/1972	8:30		11.5		0.0				4	0.03	0.04							
9/25/1973	7:45		9.4	9.0					4	0.04	0.06							
10/16/1974	8:40		10.1	4.5					4	0.05	0.09							
6/17/1975	18:20		8.7	9.0			160		13	0.05	0.09							
9/29/1976	14:20		9.6	15.0			186		10	0.05	0.07		< 1		< 10			
9/20/1977	10:00		9.5	11.0			177		10	0.08	0.22		< 1		10			
5/10/1978	14:13		9.3	14.5			105		10	0.05	0.07		< 1		20			
3/20/1979	13:15		9.8		8.8		140		10	0.02	0.06							
9/25/1979	12:00			15.5			191		2	0.04	0.06		< 1		< 10		160	
5/13/1980	14:30						105	48	14	0.05	0.10							
10/7/1980	12:40		12.0	12.0			141	7	4	0.12	0.15							
11/3/1981	11:40				7.0		194	5	1	0.06	0.29							
8/17/1982	13:45		7.4	17.2			159	14	12	0.11	0.13							
9/28/1983	13:30			11.5			149	9	12	0.11	0.15							
6/28/1988	6:45		7.4	20.8			200	35	38	0.12	0.16		< 1		< 5		430	
6/19/1989	18:36		7.2	18.5			138	27	10	0.05	0.09		< 1		10		230	
6/20/1990	18:20		11.1	11.0			161	10	5	0.04	0.08		< 1		< 5		350	
7/31/1991	17:30		9.7	25.0			156	7	4	0.12	0.15		< 1		< 5		230	
7/8/1992	19:00		7.5	19.0		8.36	179	5	4	0.06	0.09		< 1		< 5		270	105
7/13/1993	17:50		7.8	20.0			147	22	21	0.07	0.12		< 1		< 5		1160	76
8/9/1994	19:00		7.5	21.5		9.10	152	13	11	0.14	0.19		< 1		10		600	78
3/28/1995	18:00		9.9		5.0	8.23	111	28	13	0.03	0.09		< 1		10		610	65
6/6/1995	18:00		9.5	10.5		8.29	133	27	13	0.03	0.09		< 1		10		550	98
9/20/1995	12:45		13.0	14.5			153	5	3	0.14	0.16		< 1		< 5		210	93
3/26/1996	15:00		10.1	6.3		8.14	125	82	28	0.04	0.16		< 1		10		1120	76
7/30/1996	14:45		7.8	18.0		8.21	134	24	7	0.01	0.02		< 1		< 5		410	76
9/24/1996	15:50		11.5	16.0		8.85	164	3	4	0.08	0.10		< 1		10		250	108
3/25/1997	15:20		11.0		8.3	8.00	116	68	39	0.05	0.16		< 1		10		1230	66
7/8/1997	15:30		7.8	20.8		8.14	126	22	10	0.05	0.10		< 1		< 2		939	88
9/23/1997	15:00		8.8	17.0		8.44	115	6	5	0.20	0.25							
3/24/1998	15:04		11.3		5.3	7.84	131	332	227	0.03	0.43		2		27		23400	95
7/6/1998	14:45																	

Table A-2: Selected Water-Quality Data - NDEP Site E4: EF Owyhee River above Mill Creek

Date	Sample Time	Flow (cfs)	DO (mg/L)	Temperature (Degrees C) May-Oct	Temperature (Degrees C) Nov-Apr	pH (in field)	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Ortho P (mg/L)	Total P (mg/L)	Dissolved Cadmium (ug/L)	Total Cadmium (ug/L)	Dissolved Copper (ug/L)	Total Copper (ug/L)	Dissolved Iron (ug/L)	Total Iron (ug/L)	Hardness as $CaCO_3$ (mg/L)
7/7/1998	14:45						166	10		0.06	0.05		< 1		4		218	76
9/22/1998	15:35		9.6	16.8		8.60	145	10		0.15	0.30							
3/23/1999	14:55		18.2		6.9	8.00	128	26	20	0.05	0.13	< 1	< 1	< 20	< 20	390	960	79
7/6/1999	15:35		9.1	19.2		8.60	145	8	9	0.04	0.07	< 1	< 1	< 20	< 20	270	480	88
9/21/1999	16:00		8.1	17.7		8.77	137	12	5	0.10	0.14							
3/21/2000	15:10		21.2		7.7	8.23	155	43	22	0.03	0.13	< 1	< 1	< 20	< 20	380	1330	96
7/11/2000	14:50		8.8	19.0		7.60	140	4	7	0.04	0.06	< 1	< 1	< 20	< 20	300	420	83
9/19/2000	13:00		12.4	17.1		9.03	126	7	4	0.08	0.10	< 1	< 1	< 20	< 20	150	280	96
4/3/2001	13:35		10.9		5.1	8.22	108	19	13	0.02	0.06	< 1	< 1	< 20	< 20	510	960	74
7/10/2001	15:15		7.6	21.9		8.36	153	6	4	0.06	0.09	< 2	< 2	< 20	< 20	170	320	105
9/18/2001	15:05		9.4	17.8		8.70	177	15	9	0.06	0.10	< 1	< 1	< 20	< 20	60	470	105
3/26/2002	14:15		10.2		8.9	8.30	147	39	15	0.05	0.12	< 5	< 1	< 20	< 20	410	980	86
7/9/2002	15:10		10.8	18.8		9.00	158	20	11	0.09	0.13	< 2	< 2	< 20	< 20	540	820	83
8/12/2002	17:30		11.6	20.4		8.77	144	6	3	0.18	0.21							
4/22/2003	13:45		8.2		8.6	7.81	122	68	30	0.03	0.12							
8/12/2003	14:20		6.1	24.0		8.40	220	2	4	0.10	0.14	< 2	< 2	< 20	< 20	130	320	145
10/14/2003	14:45		22.8	11.8		8.00	180	24	17	0.12	0.20							
Criteria			>6	<21	<7	>=6.5 <=9	<500	<25	<10	none	<0.1	Varies	<5	Varies	<200	none	<1000	none
No. of Samples			60	46	16	27	45	39	55		59	11	32	11	32		29	
No. of Exceedances			0	7	6	2	0	12	25		33	0	0	0	0		5	
% Exceedances			0%	15%	38%	7%	0%	31%	45%		56%	0%	0%	0%	0%		17%	
Average			9.8	16.6	4.9	8.4	148.9	28.7	14.2	0.07	0.12	BDL	BDL	BDL	BDL	301	1369	
Median			9.4	17.8	5.2	8.3	147.0	14.0	8.7	0.06	0.10	BDL	BDL	BDL	BDL	300	470	
Minimum			6.1	4.5	0.0	7.6	105.0	2.0	1.0	0.01	0.01	BDL	BDL	BDL	BDL	60	160	
Maximum			22.8	25.0	8.9	9.1	220.0	332.0	227.0	0.32	0.43	BDL	BDL	10.0	27.0	540	23400	

BDL = Below detection limit
Values less than detection limit assumed to meet water quality criteria (see NAC 445A.144)
[shaded box] = water quality criteria exceeded

Table A-3: Selected Water Quality Data - NDEP Site E14: Mill Creek at Patsville

Date	Sample Time	Flow (cfs)	DO (mg/L)	Temperature (Degrees C)		pH (in field)	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Ortho P (mg/L)	Total P (mg/L)	Dissolved Cadmium (ug/L)			Total Cadmium (ug/L)	Dissolved Copper (ug/L)			Total Copper (ug/L)	Dissolved Iron (ug/L)	Total Iron (ug/L)	Hardness as $CaC0_3$ (mg/L)
				May-Oct	Nov-Apr							Data	1-hour Criteria	96-hour Criteria		Data	1-hour Criteria	96-hour Criteria				
3/25/1997	13:50					7.38									< 1				140		1,560	38
7/8/1997	15:00	0.7 (E)													2				402		6,190	107
9/23/1997	14:45	0.7 (E)	6	18		2.96	1231	25	40	0.00	0.02											
3/24/1998	14:40		12		3.8	7.87	107	202	116	0.07	0.33				2				275		13,800	53
7/7/1998	15:15	1.4 (E)					136	10		0.06	0.05				< 1				138		3,780	86
9/22/1998	15:05	0.4 (E)	7.6	15.9		4.70	908	71		0.06	0.30	9	17.0	3.0	10	2,480	58.8	34.5	3,110	50,200	74,200	424
3/23/1999	14:30		5.31		7.0	8.00	141	88	57.1	0.01	0.15	< 1			1	110	13.5	9.1	920	390	7,450	89
7/6/1999	14:48		7.82	21.9		8.28	133	16	18.9	0.03	0.07	< 1			< 1	80	13.4	9.0	190	1,730	4,270	88
9/21/1999	15:40	0.6 (E)	5.92	17.1		4.01	1105	62	387	0.01	0.04											
3/21/2000	14:20		18.8		6.2	6.79	163	88	60	0.00	0.14	2	3.1	0.9	2	30	14.2	9.5	1,120	760	9,200	94
7/11/2000	14:35	0.1 (E)	6.6	23.0		3.10	604	68	260	0.00	0.02	9	13.1	2.5	9	2,100	47.2	28.3	3,230	21,300	48,200	336
9/19/2000	14:30		5.6	21.0		2.99	1130	90	90	0.00	0.00	19	27.0	4.1	19	7,400	86.5	49.0	7,500	37,950	73,200	639
4/3/2001	13:50	28 (E)	10.49		3.4	7.00	99	16	28	0.02	0.08	< 1			< 1	190	6.7	4.8	280	4,540	6,450	42
7/10/2001	15:00	0.1 (E)	6.45	26.0		7.74	388	48	110	0.00	0.04	< 2			< 2	20	35.5	21.8	900	110	15,770	248
9/18/2001	14:50	0.0018 (E)	8.5	31.0		3.10	1060	24	20	0.00	0.09				14				4,870		12,820	548
3/26/2002	14:30	4 (E)	9		8.2	7.60	232	318	200	0.00	0.40	< 5			3	200	19.7	12.8	2,340	2,710	20,300	133
7/9/2002	14:50	1 (E)	7.51	25.2		8.20	300	32	39	0.00	0.02	< 2			< 2	30	27.4	17.3	500	400	7,970	189
8/12/2002		0																				
4/22/2003	13:30	30 (E)	7.74		8.8	7.91	106	23	21	0.02	0.08											
8/12/2003		0																				
10/14/2003	14:30	0.1 (E)	16.65	12.9		7.90	960	1	2	0.00	0.00											
Criteria			>6	<21	<7	>=6.5 <=9	<500	<25	<10	none	<0.1	Varies			<5	Varies			<200	none	<1000	none
No. of Samples			16	10	6	17	17	17	15		17	10	10	10	15		10	10	15		15	
No. of Samples (adjusted)			15	9	6	16	16	16	14		16	10	10	10	14		10	10	14		14	
No. of Exceedances			4	5	3	5	6	11	13		5		0	4	3		9	9	11		14	
% Exceedances			27%	56%	50%	31%	38%	69%	93%		31%		0%	40%	21%		90%	90%	79%		100%	
Average			8.9	21.2	6.2	6.2	517.8	69.5	96.6	0.02	0.11	5.1			4.4	1,264			1,728	12,009	20,344	
Median			7.7	21.4	6.6	7.4	300.0	48.0	57.1	0.00	0.07	BDL			2.0	150			900	2,220	9,200	
Minimum			5.3	12.9	3.4	3.0	99.0	1.0	2.0	0.00	0.00	BDL			BDL	20			138	110	1,560	
Maximum			18.8	31.0	8.8	8.3	1231.0	318.0	387.0	0.07	0.40	19.0			19.0	7,400			7,500	50,200	74,200	

Number of samples adjusted to account for extreme low flow periods
BDL = Below detection limit
Values less than detection limit assumed to meet water quality criteria (see NAC 445A.144)
BDL levels assumed to be 1/2 BDL for calculating statistics
(E) - Estimated from RTWG SW-2 flow data
= sample collected during period when flow < 7Q10 Low (Estimated at 0.03 cfs from RTWG SW-1/SW-2 data combined) - therefore, any noncompliance with standards are not included as an exceedance in the calculations
= water quality criteria exceeded

Table A-4: Selected Water Quality Data - NDEP Site E15: EF Owyhee River below Mill Creek

Date	Sample Time	Flow (cfs)	DO (mg/L)	Temperature (Degrees C)		pH (in field)	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Ortho P (mg/L)	Total P (mg/L)	Dissolved Cadmium (ug/L)			Total Cadmium (ug/L)	Dissolved Copper (ug/L)			Total Copper (ug/L)	Dissolved Iron (ug/L)	Total Iron (ug/L)	Hardness as $CaC0_3$ (mg/L)
				May-Oct	Nov-Apr							Data	1-hour Criteria	96-hour Criteria		Data	1-hour Criteria	96-hour Criteria				
3/21/2000	14:50		18.76		7.2	7.9	158	30	21	0.02	0.1	< 1			< 1	40	14.5	9.7	130	380	1720	96
7/11/2000	14:15		8	18.75		9.5	147	4	8	0.04	0.06	< 1			< 1	< 20			< 20	300	490	81
9/19/2000	15:10		9.1	18.4		8.86	135	10	3.2	0.07	0.09	2	3.3	1.0	< 1	20			< 20	220	370	100
4/3/2001	14:05		11.01		4.1	7.95	105	18	17	0.02	0.05	< 1			< 1	50	10.2	7.0	70	1460	2280	66
7/10/2001	14:15		8.4	21		8.21	177	5	4.2	0.07	0.07	< 2			< 2	< 20			< 20	170	360	107
9/18/2001	14:15		8.8	17		8.9	179	7	3.8	0.07	0.12	< 1			< 1	< 20			< 20	40	320	102
3/26/2002	14:45		9.4		9.0	7.7	154	40	21	0.02	0.11	< 5			< 2	60	14.1	9.4	190	580	2090	93
7/9/2002	14:20		9.41	18.3		8.5	164	22	11	0.08	0.12	< 2			< 2	< 20			< 20	590	810	83
8/12/2002	16:00		11.34	19.9		8.36	140	4	3.4	0.17	0.2											
4/22/2003	13:00		8.18		7.8	7.96	114	66	36	0.03	0.13											
8/12/2003	14:05		5.28	24		8.4	218	7	4.3	0.09	0.14	< 2			< 2	< 20			< 20	180	490	138
10/14/2003	14:20		14.23	10.2		8.5	185	20	17	0.11	0.19											
Criteria			>6	<21	<7	>=6.5 <=9	<500	<25	<10	none	<0.1	Varies			<5	Varies			<200	none	<1000	none
No. of Samples			12	8	4	12	12	12	12		12	9	9	9	9		9	9	9		9	
No. of Exceedances			1	2	3	1	0	3	6		8		0	1	0		3	3	0		3	
% Exceedances			8%	25%	75%	8%	0%	25%	50%		67%		0%	11%	0%		33%	33%	0%		33%	
Average			10.2	18.4	7.0	8.4	156.3	19.4	12.5	0.07	0.11	BDL			BDL	24.4			50	436	992	
Median			9.3	18.6	7.5	8.4	156.0	14.0	9.5	0.07	0.11	BDL			BDL	BDL			BDL	300	490	
Minimum			5.3	10.2	4.1	7.7	105.0	4.0	3.2	0.02	0.05	BDL			BDL	BDL			BDL	40	320	
Maximum			18.8	24.0	9.0	9.5	218.0	66.0	36.0	0.17	0.20	2.0			BDL	60.0			190	1460	2280	

BDL = Below detection limit
Values less than detection limit assumed to meet water quality criteria (see NAC 445A.144)
BDL levels assumed to be 1/2 BDL for calculating statistics
[shaded box] = water quality criteria exceeded

Table A-5: Selected Water Quality Data - NDEP Site E16: EF Owyhee River below Slaughterhouse Creek

Date	Sample Time	Flow (cfs) - Sta. 13175100	DO (mg/L)	Temperature (Degrees C)		pH (in field)	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Ortho P (mg/L)	Total P (mg/L)	Dissolved Cadmium (ug/L)	Total Cadmium (ug/L)	Dissolved Copper (ug/L)			Total Copper (ug/L)	Dissolved Iron (ug/L)	Total Iron (ug/L)	Hardness as $CaCO_3$ (mg/L)
				May-Oct	Nov-Apr									Data	1-hour Criteria	96-hour Criteria				
3/21/2000	13:50	85	22.19		6.5	8.03	155	47	26	0.03	0.14	< 1	< 1	40	13.4	9.0	110	460	1980	88
7/11/2000	13:20	110	8.3	21		9.3	144	7	8.8	0.04	0.07	< 1	< 1	< 20			< 20	280	470	83
9/19/2000	13:25	26	9.2	18		8.78	135	8	4	0.07	0.1	< 1	< 1	< 20			< 20	170	340	101
4/3/2001	14:45	101	11.7		4	7.99	108	26	17	0.02	0.05	< 1	< 1	30	10.2	7.0	50	1010	2090	66
7/10/2001	13:35	58	6.5	21.5		8.67	177	7	3.9	0.05	0.08	< 2	< 2	< 20			< 20	190	370	107
9/18/2001	13:30	10	7.9	18		8.7	206	5	1.7	0.05	0.08	< 1	< 1	< 20		.	< 20	40	170	105
3/26/2002	15:15	69	10		8.9	8.1	149	31	17	0.03	0.1	< 5	< 2	30	13.4	9.0	100	550	1620	88
7/9/2002	13:40	124	9.27	18.3		8.3	163	18	11	0.07	0.12	< 2	< 2	< 20			< 20	500	830	86
8/12/2002	16:00	64	12.5	20.14		8.6	145	6	2.6	0.16	0.2									
4/22/2003	12:45	190	8.64		7.8	8.29	117	85	45	0.03	0.16									
8/12/2003	13:40	5.9	5.36	20		8.5	218	7	4.5	0.1	0.15	< 2	< 2	< 20			< 20	130	430	135
10/14/2003	13:55	23	18.15	10.7		9.1	183	15	16	0.12	0.2									
Criteria			>6	<21	<7	>=6.5 <=9	<500	<25	<10	none	<0.1	Varies	<5	Varies			<200	none	<1000	none
No. of Samples			12	8	4	12	12	12	12		12	9	9	9	9	9	9		9	
No. of Exceedances			1	2	2	1	0	4	6		8	0	0		3	3	0		3	
% Exceedances			8%	25%	50%	8%	0%	33%	50%		67%	0%	0%		33%	33%	0%		33%	
Average			10.8	18.5	6.8	8.5	158.3	21.8	13.1	0.06	0.12	BDL	BDL	BDL			35.6	370	922	
Median			9.2	19.1	7.2	8.6	152.0	11.5	9.9	0.05	0.11	BDL	BDL	BDL			BDL	280	470	
Minimum			5.4	10.7	4.0	8.0	108.0	5.0	1.7	0.02	0.05	BDL	BDL	BDL			BDL	40	170	
Maximum			22.2	21.5	8.9	9.3	218.0	85.0	45.0	0.16	0.20	BDL	BDL	40.0			110.0	1010	2090	

BDL = Below detection limit

Values less than detection limit assumed to meet water quality criteria (see NAC 445A.144)

BDL levels assumed to be 1/2 BDL for calculating statistics

[ ] = water quality criteria exceeded

Table A-6: Selected Water Quality Data - RTWG Site SW-1: Mill Creek above Rio Tinto Site

Date	Flow (cfs)	DO (mg/L)	Temperature (Degrees C)		pH		TDS (mg/L)	TSS (mg/L)		Turbidity (NTU)		Total P (mg/L)		Dissolved Cadmium (mg/L)	Total Cadmium (mg/L)	Dissolved Copper (mg/L)				Total Copper (mg/L)		Dissolved Iron (mg/L)		Total Iron (mg/L)		Hardness as $CaCO_3$ (mg/L)	
			May-Oct	Nov-Apr												Data		1-hour Criteria	96-hour Criteria								
9/13/1995	0		-																								
10/19/1995		8.4																									
11/16/1995		9.7																									
12/6/1995	1.9	10.4		5.3	7.7		130	8		1		0.032		< 0.0005	< 0.0005	< 0.01				< 0.01		0.05		0.08		85	
2/16/1996		11.6																									
3/20/1996		8.9																									
4/24/1996	60.9	10.3		7.5	6.4		80	60		37		0.114		< 0.0005	< 0.0005	< 0.01				< 0.01		0.13		2.51		28	
5/31/1996		8.4																									
6/27/1996		3.2																									
7/24/1996	0		-																								
8/21/1966	0.0		-																								
10/21/1996	0.5	8.3	8.0		7.3		150	< 5		0.4				< 0.0005	< 0.0005	0.001		0.0176	0.0116	0.002		0.02		0.02		118	
1/29/1997	4.1	10.9		3.9	7.7		100	< 5		8.6		0.064		< 0.0005	< 0.0005	0.001		0.0080	0.0057	0.001		0.45		0.79		51	
4/23/1997	108	9.5		5.8	6.9		80	34		28		0.149				< 0.01				< 0.01		0.32		2.88		31	
7/17/1997	1.5	7.6	17.8		8.1		130	< 5		1		0.012				< 0.001				< 0.01		0.06		0.17		91	
10/23/1997	1.3	9.0	8.4		7.8		180	< 5		0.4		0.04				0.001		0.0175	0.0115	0.001		0.05		0.07		117	
10/23/1997					7.9		180	< 5		0.3		0.03				0.001		0.0172	0.0113	< 0.01		0.04		0.06		115	
1/21/1998	4.3	10.8		4.4	7		110	8		14		0.04				0.002		0.0131	0.0088	0.002		0.16		0.3		86	
4/14/1998	23.6	13.3		6.8	7		90	6		10.4		0.05				0.001		0.0055	0.0040	0.003		0.17		1.57		34	
7/20/1998	2.3	7.7	26.1		8.3		70	< 5		1.2		0.06				< 0.001				< 0.01		0.06		0.13		87	
10/22/1998	0.7	8.5	8.9		7.8		140	8		0.5		0.01				< 0.001				< 0.01		0.06		0.07		108	
1/25/1999	1.9	10.1		1.3	7.5		110	6		1.7		0.03				< 0.001				0.001		0.06		0.15		76	
5/2/1999	Highest observed	12.7	12.8		6.6		80	70		46		0.21				0.002		0.0039	0.0030	0.006		0.22		2.6		24	
6/23/1999	16.7	10.3	12.0		7.3		90	< 5		6.3		0.03				0.001		0.0078	0.0056	0.001		0.11		0.29		50	
10/20/1999	0.3	9.0	14.2		7.3		170	< 5		0.3		0.03				< 0.001				< 0.01		0.03		0.04		124	
1/31/2000	1.2	10.4		4.5	7.3		110	< 5		1		0.01				< 0.001				0.038		0.05		0.08		89	
4/25/2000	33.5	9.0		13.8	6.8		70	< 5		11.1		0.04				< 0.001				< 0.01		0.05		1.17		23	
7/25/2000	0																										
10/23/2000	0.08	9.9	10.9		7.3		170	8		0.2		0.02				< 0.001				< 0.01		< 0.01		0.02		111	
12/4/2000	0.5	13.5		1.4	7.5		140	< 5		0.3		0.02				< 0.001				< 0.01		0.04		0.05		92	
12/21/2000	0.4	11.8		0.4	7		120	< 5		0.3		0.01				< 0.001				< 0.01		< 0.01		0.03		90	
1/26/2001	-	8.7		0.4	6.6		110	6		2.2		0.01				< 0.001				< 0.01		0.05		0.03		84	
2/26/2001	2.4	11.6		0.4	7		120	< 5		0.7		0.02				< 0.001				0.002		0.03		0.07		71	
3/28/2001	51.5	9.4		7.9	6.7		110	14		24.5		0.1				0.002		0.0062	0.0045	0.005		1.28		2.38		39	
4/23/2001	33.8	8.9		10.1	7		110	12		18.7		0.04	(J)			0.002		0.0048	0.0036	0.004		0.39		1.88		30	
5/23/2001	14	7.8	18.3		6.6		70	10		11.2		0.05				0.001		0.0061	0.0044	0.002		0.19		0.38		38	
6/7/2001	2.9	9.0	14.6		7.5		100	< 5		4.9		0.04				< 0.001				0.001		0.11		0.42		55	
6/28/2001	0.2	7.2	23.3		7.7		110	< 5		0.9		0.05				0.001		0.0118	0.0080	< 0.01		0.04		0.12		77	
7/7/2001			19.5																								
7/8/2001			17.4																								
7/9/2001			17.6																								
7/10/2001			17.1																								
7/11/2001			15.8																								
11/28/2001	0.4	17.0		0.4	7		130	< 5		0.3		0.03	(J)	< 0.0001		< 0.001				0.001		0.04	(J)	0.1		105	
12/19/2001	0.5	17.2		2.2	6.5		130	< 5		1.1		0.01		< 0.0001		< 0.001				< 0.01		0.03		0.45		84	
1/31/2002	0.69	11.6		0.2	6.6	(J)	110	< 5		1	(J)	0.01		< 0.0001	< 0.0001	0.0012		0.0102	0.0070	0.0049	(J)	0.05		0.09	(J)	66	
2/19/2002	1.09	12.5		0.3	6.7	(J)	90	< 5		1	(J)	0.03		< 0.0001	< 0.0001	0.0006		0.0106	0.0073	0.02		0.04		0.07		69	
3/21/2002	2.6	10.6		5.6	6.7	(J)	100	< 5	(J)	3.1	(J)	0.03		< 0.0001	< 0.0001	0.0011		0.0095	0.0066	0.0014	(J)	0.08		0.48	(J)	61	
4/23/2002	26.4	10.6		5.2	6.5	(J)	90	< 5		11.7	(J)	0.06		< 0.0001	< 0.0001	0.0018		0.0047	0.0035	0.0029		0.25		1.48		29	
5/22/2002	19.7	11.9	5.2		6.6	(J)	80	8		7.4	(J)	0.03		< 0.0001	< 0.0001	0.0013		0.0048	0.0036	0.0024		0.14		0.83	(J)	30	(J)
6/25/2002	2.59	8.4	13.6		6.9	(J)	110	12		2.8	(J)	0.06	(J)	< 0.0001	< 0.0001	0.0007	(J)	0.0099	0.0069	0.002	(J)	0.09	(J)	0.16	(J)	64	
11/21/2002	0.1547	8.8		6.8	6	(J)	140	< 5		0.4	(J)	0.06		< 0.0001	< 0.0001	0.0007		0.0138	0.0093	0.0022	(J)	< 0.01		0.08		91	
12/18/2002	0.61			0.5	7.7	(J)	120	< 5		0.3	(J)	0.03		< 0.0001	< 0.0001	0.0006		0.0116	0.0079	0.001	(J)	- 0.02		0.02		76	
1/30/2003	1.85	6.6		4.5	7	(J)	80	< 5		1.1	(J)	0.03		< 0.0001	< 0.0001	0.0025	(J)	0.0126	0.0086	0.0013	(J)	0.03		0.13	(J)	83	
2/26/2003	1.73	7.3		0.4	7.6	(J)	100	< 5		0.8	(J)	0.03		< 0.0001	< 0.0001	< 0.0005				0.0011	(J)	0.02		0.09		82	
3/26/2003	29.41	10.5		2.1	7	(J)	90	236		170	(J)	0.28		< 0.0001	< 0.0004	0.0017		0.0056	0.0041	0.0144	(J)	0.15		10.9	(J)	35	
4/30/2003	31.6	11.4		6.6	6.8	(J)	80	12		13.1	(J)	0.06	(J)	< 0.0001	< 0.0001	0.0016	(J)	0.0047	0.0035	0.004		0.55	(J)	2.1		29	
5/21/2003	22.96	8.3	14.1		6.8	(J)	70	12		14.5	(J)	0.08	(J)	< 0.0001	< 0.0001	0.0016		0.0045	0.0034	0.0056	(J)	0.16	(J)	1.47	(J)	28	
6/19/2003	1.61	8.7	16.7		7.1	(J)	90	8		5.9	(J)	0.08	(J)	< 0.0001	< 0.0001	< 0.0005				0.0017	(J)	0.1	(J)	0.41	(J)	62	

Table A-6: Selected Water Quality Data - RTWG Site SW-1: Mill Creek above Rio Tinto Site

Date	Flow (cfs)	DO (mg/L)	Temperature (Degrees C)		pH	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Total P (mg/L)	Dissolved Cadmium (mg/L)	Total Cadmium (mg/L)	Dissolved Copper (mg/L)			Total Copper (mg/L)	Dissolved Iron (mg/L)	Total Iron (mg/L)	Hardness as $CaCO_3$ (mg/L)
			May-Oct	Nov-Apr								Data	1-hour Criteria	96-hour Criteria				
Criteria		>6	<21	<7	>=6.5 <=9	<500	<25	<10	<0.1	Varies	<0.005	Varies			<0.20	none	<1.0	none
No. of Samples		48	21	27	44	44	44	44	43	20	18	44	44	44	44		44	
No. of Samples (adjusted)		46	20	27	42	42	42	42	41	20	18	42	42	42	42		42	
No. of Exceedances		1	2	4	2	0	2	11	3	0	0		0	0	0		9	
% Exceedances		2%	10%	15%	5%	0%	5%	26%	7%	0%	0%		0%	0%	0%		21%	
Average		9.9	14.9	4.0	7.1	110	15.1	10.6	0.05	BDL	BDL	BDL			0.0048	0.14	0.85	
Median		9.6	14.6	4.4	7.0	110	5.0	1.5	0.03	BDL	BDL	BDL			0.0045	0.06	0.16	
Minimum		3.2	5.2	0.2	6.0	70	5.0	0.2	0.01	BDL	BDL	BDL			BDL	0.01	0.02	
Maximum		17.2	26.1	13.8	8.3	180	236.0	170.0	0.28	BDL	BDL	0.0025			0.0380	1.28	10.90	

Number of samples adjusted to account for extreme low and high flow periods
BDL = Below detection limit
Values less than detection limit assumed to meet water quality criteria (see NAC 445A.144)
BDL levels assumed to be 1/2 BDL for calculating statistics
(J) = indicates that this concentration is an estimated value- it was qualified as such on the basis of QC/QA evaluations such as exceedance of hold time, matrix spike recoveries, serial dilutions, etc.
= sample collected during period when flow < 7Q10 Low (Estimated at 0.03 cfs from RTWG SW-1/SW-2 data combined) - therefore, any noncompliance with standards are not included as an exceedance in the calculations
= sample collected during period when flow > 7Q10 High (Estimated at >107 cfs from RTWG SW-1/SW-2 data combined) - therefore, any noncompliance with standards are not included as an exceedance in the calculations
= water quality criteria exceeded

Table A-7: Selected Water Quality Data - RTWG Site SW-2: Mill Creek above Owyhee River confluence

Date	Flow (cfs)	DO (mg/L)	Temperature (Degrees C) May-Oct	Temperature (Degrees C) Nov-Apr	pH	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Total P (mg/L)	Dissolved Cadmium (mg/L) Data	Dissolved Cadmium (mg/L) 1-hour Criteria	Dissolved Cadmium (mg/L) 96-hour Criteria	Total Cadmium (mg/L)	Dissolved Copper (mg/L) Data	Dissolved Copper (mg/L) 1-hour Criteria	Dissolved Copper (mg/L) 96-hour Criteria	Total Copper (mg/L)	Dissolved Iron (mg/L)	Total Iron (mg/L)	Hardness as $CaCO_3$ (mg/L)
9/13/1995	0	-	-																	
10/19/1995	-	6.3	12.7																	
11/16/1995	0.8	9.1		11.9																
12/6/1995	2.1	9.3		4.9	4	510	60	48	0.133	0.006	0.0101	0.0021	0.0042	5.04	0.0380	0.0233	5.13	13.2	25.5	267
1/16/1996	3.0	12.0		2.6																
2/16/1996	9.0	10.7		7.9																
3/20/1996	21.7	9.9		13.1																
4/24/1996	68.6	9.6		5.3	6.2	90	52	36	0.118	< 0.0005			0.001	0.06	0.0059	0.0043	0.21	0.32	3.81	37
5/31/1996	24.0	8.3	18.0																	
6/27/1996	7.8	3.0	20.9																	
7/24/1996	0.1	2.7	23.8		4	410	16	46	0.49	0.0034	0.0088	0.0019	0.003	0.84	0.0340	0.0210	1.15	7	14	237
8/21/1996	0	-	-																	
10/21/1996	0.8	11.3	2.3		4.3	800	8	17.9		0.011	0.0197	0.0033	0.01	2.73	0.0666	0.0387	2.7	10.2	12.3	484
1/29/1997	7.8	8.8		1.9	4.7	280	92	88	0.139	0.0024	0.0046	0.0012	0.0027	2	0.0196	0.0127	2.3	16.7	23.2	132
4/23/1997	108 (E)	7.5		6.2	6.4	80	58	44.7	0.093				0.003	0.06	0.0050	0.0037	0.21	0.51	6.22	31
7/17/1997	0.7	7.4	19.2		7.2	230	28	25	< 0.01					0.015	0.0212	0.0137	0.26	0.05	6.69	144
10/23/1997	1.1	10.2	5.9		5.9	490	186	11.1	0.15					0.013	0.0480	0.0287	0.92	4.93	41.1	342
1/21/1998	2.6	-		0.4	6.6	150	42	10.6 (J)	0.02					0.013	0.0182	0.0119	0.29	0.12 (J)	6.61	122
4/14/1998	25.9	12.3		5.2	6.8	100	< 5	13.9	0.05					0.072	0.0067	0.0048	0.098	0.96	2.69	42
7/20/1998	1.4	8.0	25.7		8	190	14	34	0.03					0.009	0.0196	0.0127	0.209	0.08	8.8	132
10/22/1998	0.4	8.1	8.9		6.6	320	114	198	< 0.01					0.036	0.0299	0.0187	0.065	0.85	42.9	207
1/25/1999	3.9	9.8		1.1	7.1	190	46	92	0.03					0.012	0.0200	0.0130	0.76	< 0.01	17	135
5/2/1999	Highest observed	11.9	13.7		6.5	120	64	60	0.14					0.141	0.0062	0.0045	0.31	0.62	4.39	39
6/23/1999	16.7	8.9	18.0		7.1	100	< 5	8.3	0.03					0.041	0.0089	0.0062	0.071	0.79	2.09	57
10/20/1999	0.6	11.8	12.5		6.5	410	46	120	0.01					0.031	0.0380	0.0233	1.58	0.29	30.6	267
1/31/2000	2.0	11.2		11.0	6.3	250	44	85	0.01					0.018	0.0248	0.0158	0.95	0.44	17.7	170
4/25/2000	33.0	7.8		12.6	6.6	80	10	12.2	< 0.01					0.038	0.0048	0.0036	0.048	0.73	2.05	30
7/25/2000	0.05	6.5	23.3		3.4	900	52	115	< 0.01					4.5	0.0679	0.0394	4.5	33.4	45.9	494
9/26/2000	-	-	10.3																	
10/23/2000	0.4	9.4	15.4		5.6	400	58	108	< 0.01					0.26	0.0344	0.0212	1.11	0.81 (J)	18.5	240
10/23/2000					5.7	390	50	107	0.01					0.2	0.0345	0.0213	1.12	0.49 (J)	18	241
12/4/2000	0.6	12.3		0.1	6.1	310	52	118	0.02					0.031	0.0274	0.0173	1.08	4.56	25.7	189
12/21/2000	0.9	11.0		0.1	5.1	330	84	179	0.02					0.144	0.0296	0.0186	2	16.1	39.4	205
1/27/2001	-	8.3		0.1	6.4	270	38	61 (J)	< 0.01					0.019	0.0274	0.0173	0.83	1.14	15.5	189
1/27/2001					6.3	270	36	77 (J)	0.01					0.02	0.0266	0.0168	0.82	1.13	15.8	183
2/27/2001	1.2	11.9		0.0	4.9	610	90	302	0.02					1.09	0.0423	0.0256	2.56	43.6	70.8	299
3/28/2001	27.1	10.9		4.6	6.7	130	8	26.5	0.08					0.103	0.0075	0.0054	0.181	0.99	3.83	48
4/24/2001	29.5	10.2		7.3	6.6	100	< 5	23	0.04					0.069	0.0056	0.0041	0.099	0.96	2.91	35
5/23/2001	12.8	8.2	16.1		6.9	80	10	13.2	0.08					0.072	0.0072	0.0052	0.106	1.22	1.96	46
6/7/2001	4.8	9.4	13.6		6.6	140	< 5	13.6	0.04					0.028	0.0115	0.0079	0.28	0.4	4.04	75
6/28/2001	0.4	7.3	21.0		7.5	310	22	60.4	0.03					0.018	0.0299	0.0187	0.7	0.2	12.1	207
7/17/2001	0.014	5.2	20.6		5.9	510	12 (J)	24.3	< 0.01					0.23	0.0496	0.0296	0.24	0.02 (J)	3.83	354
7/19/2001	-	4.9	18.4		5.4	3700	86	198	0.02					0.37	0.3127	0.1573	1.83	2.77	28.1	2500
8/21/2001	0	-	-																	
9/19/2001	0.0018	5.1	10.8		6	860	8	0.6	0.02 (J)					0.122	0.0798	0.0456	0.148	0.16	0.24 (J)	587
10/24/2001	0.0089	6.0	6.7		6	1000	< 5	0.3 (J)	0.03 (J)					0.107	0.0903	0.0510	0.09	0.08	0.12	669
11/28/2001	0.8	18.1		0.1	5.3	540	66	137	0.03 (J)	0.0055	0.0122	0.0024		0.65	0.0445	0.0269	2.1	15.6	35.4	316
12/19/2001	0.8	17.1		1.1	5.1	380	82	153	0.03	0.0045	0.0081	0.0018		0.7	0.0315	0.0196	2.5	19.7	42.5	219
1/31/2002	2	12.6		0.2	5.9	230	48	92.5 (J)	< 0.01	0.0019	0.0055	0.0014	0.003	0.052	0.0228	0.0146	1.03	2.64	20.1	155
2/20/2002	1.9	13.1		0.3	7 (J)	210 (J)	44	76.4 (J)	0.03	0.0011	0.0044	0.0012	0.0019	0.014	0.0190	0.0124	0.91	1.07	17.8	128
3/20/2002	3.54	9.6		8.0	6.1 (J)	250	78	62.5 (J)	0.08	0.002	0.0055	0.0014	0.0024	0.035	0.0230	0.0148	1.32	0.06	12.2	157
4/22/2002	26.28	8.6		12.1	6.8 (J)	80	6	14.4 (J)	0.07	0.0004	0.0010	0.0004	0.0003	0.064	0.0055	0.0040	0.092	0.92	2.55	34
5/22/2002	22.49	12.7	4.8		6.5 (J)	80	6	10 (J)	0.02	< 0.0002			< 0.001	0.061	0.0058	0.0042	0.1	1.07	2.14 (J)	36
6/25/2002	2.87	7.0	20.6		7 (J)	140	< 5	11.5 (J)	0.04 (J)	< 0.0002			0.0004	0.023	0.0126	0.0086	0.214	0.31	4.21 (J)	83
7/24/2002	0.637	7.7	17.2		4.3 (J)	1400	30	51	0.02 (J)	0.0191	0.0329	0.0047	0.0172	6.88	0.1021	0.0570	7.31	30.8	38.2 (J)	762
8/20/2002	0	-	-																	
9/22/2002	0	-	-																	
10/24/2002	0.0048	6.6	6.9		5.3 (J)	760	6 (J)	1.4 (J)	0.01 (J)	0.0019	0.0209	0.0035	0.0018	0.0696	0.0699	0.0404	0.0662	0.84	0.97	510
11/21/2002	-	9.0		5.6	5.2 (J)	350	56	77.8	0.03 (J)	0.003	0.0082	0.0018	0.0049	0.18	0.0318	0.0198	1.41	1.27	19.2	221
12/19/2002	0.34	10.2		0	6.7 (J)	350	26	53 (J)	0.01	0.0022	0.0088	0.0019	0.0029	0.0256	0.0340	0.0210	0.667	0.12	10.5	237
1/31/2003	2.77	6.5		4.7	6.8 (J)	210	32	40.4 (J)	0.03	0.0012	0.0048	0.0012	0.0021	0.0239	0.0204	0.0132	1	< 0.01	9.74	138
2/26/2003	5.8	7.5		0.2	7.1 (J)	160	20	5.8 (J)	0.03	0.0005	0.0038	0.0011	0.0011	0.0115 (J)	0.0169	0.0112	0.753	< 0.01	11.6	113
3/26/2003	27.67	9.8		2.9	6.9 (J)	110	86	68 (J)	0.14	0.0003	0.0017	0.0006	0.0007	0.108	0.0084	0.0059	0.386	0.45	8.15	54
4/30/2003	32.7	11.72		6.6	6.9 (J)	80	16	14.9 (J)	0.06 (J)	0.0001	0.0010	0.0004	0.0004	0.0562	0.0056	0.0041	0.0991	0.84 (J)	2.73	35
5/21/2003	26.8	8.59	14.9		7.3 (J)	70	14	19.5 (J)	0.08 (J)	0.0001	0.0010	0.0004	0.0002	0.0408 (J)	0.0056	0.0041	0.0683 (J)	0.44 (J)	2.02 (J)	35
6/19/2003	1.74	7.39	19.4		7 (J)	140	< 5	8.7	0.05 (J)	0.0006	0.0029	0.0009	0.0004	0.17	0.0135	0.0091	0.208	2.2 (J)	3.22 (J)	89
11/19/2003	0.05				5.9 (J)	410	20	32	0.01	0.0052	0.0105	0.0021	0.0044	0.41 (J)	0.0393	0.0240	0.996 (J)	1.74	8.54 (J)	277

Table A-7: Selected Water Quality Data - RTWG Site SW-2: Mill Creek above Owyhee River confluence

Date	Flow (cfs)	DO (mg/L)	Temperature (Degrees C)		pH	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Total P (mg/L)	Dissolved Cadmium (mg/L)			Total Cadmium (mg/L)	Dissolved Copper (mg/L)			Total Copper (mg/L)	Dissolved Iron (mg/L)	Total Iron (mg/L)	Hardness as $CaCO_3$ (mg/L)
			May-Oct	Nov-Apr						Data	1-hour Criteria	96-hour Criteria		Data	1-hour Criteria	96-hour Criteria				
Criteria		>6	<21	<7	>=6 5 <=9	<500	<25	<10	<0.1	Varies			<0.005	Varies			<0.20	none	<1.0	none
No. of Samples		57	28	31	54	54	54	54	53	24	24	24	23	54	54	54	54		54	
No. of Samples (adjusted)		51	23	30	48	48	48	48	47	23	23	23	21	48	48	48	48		48	
No. of Exceedances		3	4	8	23	7	29	45	6		0	11	2		34	43	37		48	
% Exceedances		6%	17%	27%	48%	15%	60%	94%	13%		0%	48%	10%		71%	90%	77%		100%	
Average		9.2	15.1	4.5	6.1	390	39 9	61.2	0.05	0.00305			0.0030	0.5209			1.0405	4.55	15.30	
Median		9 1	15.7	4 6	6.4	260	34.0	45 4	0.03	0 00190			0.0021	0.0625			0.7265	0.85	11 05	
Minimum		2.7	2.3	0.0	3 4	70	5.0	0 3	0.01	BDL			0.0002	0.0090			0 0480	0.01	0 12	
Maximum		18 1	25.7	13 1	8 0	3700	186.0	302.0	0.49	0 01910			0 0172	6.8800			7 3100	43 60	70.80	

Number of samples adjusted to account for extreme low and high flow periods

BDL = Below detection limit

Values less than detection limit assumed to meet water quality criteria (see NAC 445A.144)

BDL levels assumed to be 1/2 BDL for calculating statistics

(J) = indicates that this concentration is an estimated value- it was qualified as such on the basis of QC/QA evaluations such as exceedance of hold time, matrix spike recoveries, serial dilutions, etc.

(E) = estimated from SW-1 flows

= sample collected during period when flow < 7Q10 Low (Estimated at 0 03 cfs from RTWG SW-1/SW-2 data combined) - therefore, any noncompliance with standards are not included as an exceedance in the calculations

= sample collected during period when flow > 7Q10 High (Estimated at >107 cfs from RTWG SW-1/SW-2 data combined) - therefore, any noncompliance with standards are not included as an exceedance in the calculations

= water quality criteria exceeded

Table A-8: Selected Water Quality Data - RTWG Site SW-3: EF Owyhee River above Mill Creek

Date	Flow (cfs)	DO (mg/L)	Temperature (Degrees C)		pH		TDS (mg/L)		TSS (mg/L)		Turbidity (NTU)		Total P (mg/L)		Dissolved Cadmium (mg/L)	Total Cadmium (mg/L)	Dissolved Copper (mg/L)				Total Copper (mg/L)		Dissolved Iron (mg/L)		Total Iron (mg/L)		Hardness as $CaCO_3$ (mg/L)
			May-Oct	Nov-Apr													Data		1-hour Criteria	96-hour Criteria							
9/13/1995	39.7	8.4	13.6		7.3		160		< 5		4.8		0.229		< 0.0005	< 0.0006	< 0.01				< 0.01		0.11		0.51		102
10/19/1995	26.0	11.1	12.9																								
11/16/1995	16.0	10.7		9.6																							
12/6/1995	27.2	9.9		5.1	7		190		< 5		8.8		0.06		< 0.0005	< 0.0005	< 0.01				< 0.01		0.04		0.94		140
1/16/1996	23.0	11.3		2.8																							
2/16/1996	87.1	10.8		9.4																							
3/20/1996	174	10.1		13.9																							
4/24/1996	236	10.0		11.1	6.7		100		56		27		0.061		< 0.0005	< 0.001	< 0.01				< 0.01		0.08		1.73		57
5/31/1996	306	8.7	17.3																								
6/27/1996	153	3.4	21.1																								
7/24/1996	131	3.7	23.2		8.3		130		< 5		5.5		0.059		< 0.0005	< 0.0005	0.001		0.0136	0.0092	0.002		0.15		0.64		90
8/21/1996	116	7.0	15.6																								
10/21/1996	27.9	10.9	6.4		7.5		170		12		5.4		0.07		< 0.0005	< 0.0005	0.008		0.0183	0.0120	0.003		0.08		0.37		123
1/29/1997	78.6	7.5		5.8	7.8		140		12		8.9		0.066		< 0.0005	< 0.0005	< 0.001				< 0.001		0.18		0.68		92
4/23/1997	-	4.0		6.4	7.5		100		62		49.2		0.104				< 0.01				< 0.01		0.14		3.46		51
7/17/1997	163	8.8	16.6		8		150		38		7		0.041				0.001		0.0138	0.0093	0.007		0.14		1.25		91
10/23/1997	28.6	9.3	6.9		8.1		180		< 5		2.1		0.04				0.002		0.0197	0.0128	0.001		0.08		0.38		133
1/21/1998	45.7	-		3.0	7.4		160		22		5.7		0.08				0.002		0.0180	0.0118	0.002		0.2		0.84		121
4/14/1998	148	11.7		5.3	7.4		110		20		7.6		0.05				< 0.001				0.003		0.12		1.15		67
7/20/1998	168	9.0	24.9		8.5		130		< 5		3.7		0.06				< 0.001				< 0.001		0.1		0.71		85
10/22/1998	48.9	10.4	9.0		8.4		150		8		2.9		< 0.01				< 0.001				< 0.001		0.09		0.38		106
1/25/1999	28.5	8.8		1.1	7.5		160		6		7.3		0.07				< 0.001				0.002		0.11		0.84		109
5/2/1999	-	11.0	11.7		7		90		38		32		0.1				0.001		0.0089	0.0062	0.004		0.18		2.6		57
6/23/1999	-	9.8	16.7		7.7		150		8		4.8		0.03				0.001		0.0139	0.0094	0.002		0.1		0.5		92
10/20/1999	22.3	11.1	10.7		7.9		180		< 5		1.8		0.03				0.002		0.0218	0.0140	0.001		0.02		0.26		148
1/31/2000	19.1	11.1		14.3	7.8		180		6		1.4		0.01				< 0.001				< 0.001		0.04		0.26		149
4/25/2000	131	7.6		11.3	7.1		100		14		14.3		0.03				< 0.001				< 0.001		0.1		1.16		53
7/25/2000	103	8.4	21.7		8		130		< 5		4.8		0.1				< 0.001				0.002		0.14		0.51		87
10/23/2000	6.2	10.6	14.6		7.7		190		8		2.8		0.02				< 0.001				< 0.001		0.02		0.22		153
12/4/2000	20.7	11.9		0.3	8.1		200		< 5		3.1		0.02				< 0.001				< 0.001		0.01		0.3		154
12/21/2000	16.0	12.7		0.1	7.7		180		5		1.5		0.02				0.001		0.0226	0.0145	< 0.001		0.07		0.21		154
1/27/2001	-	8.6		0.1	7.3		180		6		1.8		0.02				< 0.001				< 0.001		0.02		0.18		150
2/27/2001	4.2	12.9		0.8	7.8		190		< 5		2.7		0.03				< 0.001				0.002		0.03		0.32		141
3/28/2001	121	10.2		4.6	7.1		160		26		20.1		0.13				0.001		0.0132	0.0089	0.003		0.17		1.81		87
4/24/2001	122	10.5		5.3	7.2		120		14		24.1		0.05				0.001		0.0092	0.0064	0.003	(J)	0.13		1.8		59
5/23/2001	149	9.3	13.2		7		140		34		23.1		0.11				0.002		0.0124	0.0084	0.002		0.55		0.85		81
6/7/2001	211	8.8	12.5		7.5		160		8		10.5		0.05				< 0.001				0.003		0.12		0.4		90
6/28/2001	147	8.8	15.3		7.7		140				9.6		0.07				< 0.001				< 0.001		0.09		0.89		87
7/17/2001	58.2	7.2	17.1		8		170		10	(J)	1.9		0.09				0.001		0.0168	0.0111	< 0.001		0.04		0.25		112
8/21/2001	53.9	9.1	17.3		7.9		150		< 5		2.6		0.11				0.001		0.0138	0.0093	< 0.001		0.04		0.41		91
9/19/2001	9.3	8.1	12.3		7.6		170		6		3.9		0.05	(J)			< 0.001				< 0.001		0.06		0.44	(J)	117
10/24/2001	9.7	9.4	6.7		7.3		200		< 5		6.4		0.07				< 0.001				< 0.001		0.08		0.47		126
11/28/2001	8.0	17.8		0.6	7.5		230		< 5		2.7		0.03	(J)	< 0.0001		< 0.001				< 0.001		0.03	(J)	0.38	(J)	174
12/19/2001	11.6	18.3		0.4	7.6		200		< 5		1.3		0.01		< 0.0001		< 0.001				0.001		0.02		0.2		156
1/31/2002	14.0	11.3		0.8	7.5	(J)	190		< 5		1.6	(J)	0.01		< 0.0001	< 0.0001	< 0.0005				0.0038	(J)	0.02		0.21	(J)	149
2/20/2002	14.8	10.9		0.2	7.3	(J)	180	(J)	< 5		2.6	(J)	0.04		< 0.0001	< 0.0001	< 0.0005				0.0006		0.06		0.24		124
3/21/2002	50.0	11.29		1.7	7	(J)	150		8	(J)	16.7	(J)	0.09		< 0.0001	< 0.0001	0.0009		0.0136	0.0092	0.0022	(J)	0.14		1.63	(J)	90
4/23/2002	128	10.13		8.3	6.9	(J)	100		6		11.4	(J)	0.06		< 0.0001	< 0.0001	0.0009		0.0084	0.0059	0.0018		0.14		1.19		54
5/21/2002	110	10.1	8.6		7.4	(J)	130		10		9.5	(J)	0.04		< 0.0001	< 0.0001	0.001		0.0119	0.0081	0.0019		0.12	(J)	0.58		78
6/25/2002	175	8.1	18.2		7.6	(J)	160		12		10.6	(J)	0.09	(J)	< 0.0001	< 0.0002	0.0012	(J)	0.0135	0.0091	0.02		0.19	(J)	0.58	(J)	89
7/24/2002	120	7.64	12.5		7.6	(J)	140	(J)	10	(J)	8.3		0.15		< 0.0002	< 0.002	0.004		0.0134	0.0090	0.03		0.16		0.92	(J)	88
8/20/2002	60.7	8.58	17.9		7.5	(J)	150		< 5		3.3		0.13		< 0.0002	< 0.0002	0.003		0.0131	0.0088	0.001		0.07	(J)	0.3	(J)	86
9/22/2002	14.7	9.32	9.6		6.3	(J)	160		< 5		3	(J)	0.09	(J)	< 0.0002	< 0.0001	0.001	(J)	0.0144	0.0096	0.0018		0.07		0.35		95
10/24/2002	9.1	10.25	3.6		7	(J)	180		< 5	(J)	2.8	(J)	0.05	(J)	< 0.0001	< 0.0001	0.0009	(J)	0.0217	0.0140	0.0015	(J)	0.02	(J)	0.27		147
11/21/2002	14.0	10.84		4.8	6.3	(J)	200		< 5		1.5	(J)	0.03		< 0.0001	< 0.0001	0.0008		0.0236	0.0151	0.0022	(J)	0.01		0.16		161
12/19/2002	32.0	10.6		0.2	7.8	(J)	170		< 5		4.2	(J)	0.04	(J)	< 0.0001	< 0.0001	0.0006		0.0201	0.0131	0.0015	(J)	0.02		0.33		136
1/31/2003	30.8	6.48		3.4	7.9	(J)	170		8		6.8	(J)	0.07		< 0.0001	< 0.0001	0.001		0.0192	0.0125	0.0032		0.04		0.65		129
2/26/2003	18.7	7.48		2.4	7.8	(J)	160		6		2.6	(J)	0.04		< 0.0001	< 0.0001	0.0006		0.0203	0.0132	0.0013	(J)	0.02		0.27		137

Table A-8: Selected Water Quality Data - RTWG Site SW-3: EF Owyhee River above Mill Creek

Date	Flow (cfs)	DO (mg/L)	Temperature (Degrees C)		pH		TDS (mg/L)		TSS (mg/L)		Turbidity (NTU)		Total P (mg/L)		Dissolved Cadmium (mg/L)	Total Cadmium (mg/L)	Dissolved Copper (mg/L)				Total Copper (mg/L)		Dissolved Iron (mg/L)		Total Iron (mg/L)		Hardness as $CaCO_3$ (mg/L)
			May-Oct	Nov-Apr													Data		1-hour Criteria	96-hour Criteria							
3/26/2003	-	10.98		4.6	7.1	(J)	150		260		166	(J)	0.57		< 0.0001	0.0004	0.0012		0.0129	0.0087	0.0112		0.12		12		85
4/30/2003	137.4	11.13		7.6	6.8	(J)	110		16		10	(J)	0.05	(J)	< 0.0001	< 0.0001	0.0059	(J)	0.0087	0.0061	0.0029		0.31	(J)	0.46		56
5/21/2003	130.9	9.19	16.6		6.9	(J)	110		14		12.2	(J)	0.08		< 0.0001	< 0.0001	0.0021		0.0115	0.0079	0.0022	(J)	0.16	(J)	1.06		75
6/19/2003	144.5	8.11	16.6		7.7	(J)	160		12		8.3		0.1		< 0.0001	< 0.0001	< 0.01				< 0.01		0.08	(J)	0.7	(J)	96
7/24/2003	103.2	8.01	17.9		7	(J)	160		12		4		0.25	(J)	< 0.0001	< 0.0001	0.0015	(J)	0.0138	0.0093	0.0017		0.04	(J)	0.4		91
8/28/2003	3.9	8.35	19.9		8.2	(J)	170	(J)	< 5		3.7		0.12		< 0.0001	< 0.0001	0.0008		0.0185	0.0121	0.0014	(J)	0.08	(J)	0.3		124
9/15/2003	5.9	6.04	11.7		8	(J)	220		8		8.8		0.12	(J)	< 0.0001	< 0.0001	0.0008	(J)	0.0265	0.0168	0.0051		0.03	(J)	0.65		182
10/16/2003	27	8	9.2		8.3	(J)	170		14	(J)	26.3		0.16		< 0.0002	< 0.0001	0.001	(J)	0.0166	0.0110	0.0026	(J)	0.02	(J)	1.43		111
11/19/2003	12.7	10.75		5.8	8.5	(J)	160		10		11.6		0.1	(J)	< 0.0001	< 0.0001	0.0006	(J)	0.0194	0.0127	0.0021	(J)	0.03		0.75	(J)	131

Criteria	>6	<21	<7	>=6.5 <=9	<500	<25	<10	<0.1	Varies	<0.005	Varies			<0.20	none	<1.0	none
No. of Samples	66	35	32	59	59	58	59	59	31	29	59	59	59	59		59	
No. of Exceedances	3	4	8	2	0	7	16	16	0	0		0	0	0		13	
% Exceedances	5%	11%	25%	3%	0%	12%	27%	27%	0%	0%		0%	0%	0%		22%	
Average	9.6	14.3	4.7	7.5	157	16.0	11.2	0.08	BDL	BDL	0.0020			0.0036	0.10	0.91	
Median	9.6	14.6	4.6	7.5	160	8.0	5.5	0.06	BDL	BDL	BDL			0.0020	0.08	0.51	
Minimum	3.4	3.6	0.1	6.3	90	5.0	1.3	0.01	BDL	BDL	BDL			0.0006	0.01	0.16	
Maximum	18.3	24.9	14.3	8.5	230	260.0	166.0	0.57	BDL	0.0004	0.0080			0.0300	0.55	12.00	

BDL = Below detection limit

Values less than detection limit assumed to meet water quality criteria (see NAC 445A.144)

BDL levels assumed to be 1/2 BDL for calculating statistics

(J) = indicates that this concentration is an estimated value- it was qualified as such on the basis of QC/QA evaluations such as exceedance of hold time, matrix spike recoveries, serial dilutions, etc.

[shaded box] = water quality criteria exceeded

Table A-9: Selected Water Quality Data - RTWG Site SW-4: EF Owyhee River below Mill Creek

Date	Flow (cfs)	DO (mg/L)	Temperature (Degrees C)		pH	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Total P (mg/L)	Dissolved Cadmium (mg/L)			Total Cadmium (mg/L)	Dissolved Copper (mg/L)			Total Copper (mg/L)	Dissolved Iron (mg/L)	Total Iron (mg/L)	Hardness as $CaCO_3$ (mg/L)
			May-Oct	Nov-Apr						Data	1-hour Criteria	96-hour Criteria		Data	1-hour Criteria	96-hour Criteria				
9/13/1995	40.0	9.1	16.4		7.8	160	< 5	3.4	0.23	0.003	0.0033	0.0010	< 0.0006	0.01	0.0151	0.0101	0.01	0.08	0.52	100
10/19/1995	28.4	10.8	13.1																	
11/16/1995	19.0	10.3		9.7																
12/6/1995	31.3	9.8		5.0	7	230	32	30	0.07	0.001	0.0059	0.0014	0.0009	0.08	0.0242	0.0154	0.89	0.3	5.21	165
1/16/1996	32.9	11.7		1.7																
2/16/1996	97.8	11.0		7.8																
3/20/1996	182	9.8		13.6																
4/24/1996	314	10.1		8.3	6.3	90	64	36	0.092	< 0.0005			< 0.001	0.05	0.0067	0.0048	0.013	0.26	3.45	42
5/31/1996	302	7.9	18.9																	
6/27/1996	155	3.2	19.2																	
7/24/1996	130	3.6	24.9		8.2	140	6	7.3	0.072	< 0.0005			< 0.0005	0.012	0.0134	0.0090	0.005	0.07	0.74	88
8/21/1996	121	7.5	17.1																	
10/21/1996	28	10.8	3.4		7.5	180	20	8.3		< 0.0005			< 0.0005	0.051	0.0199	0.0129	0.089	0.26	0.91	134
1/29/1997	81	8.6		3.3	7.6	140	14	18.8	0.083	< 0.0005			< 0.0005	0.071	0.0142	0.0095	0.161	0.5	2.85	94
4/23/1997	-	4.4		4.8	7	90	40	33	0.085				0.003	0.04	0.0058	0.0042	0.09	0.45	3.99	36
7/17/1997	158	8.5	18.3		8.3	150	16	6.6	0.024					0.002	0.0136	0.0092	0.007	0.17 (J)	0.77	90
10/23/1997	29.2	10.4	6.3		8	180	6	9	0.04					0.003	0.0200	0.0130	0.027	0.07	1.35	135
1/21/1998	45.7	-		0.2	7.4	170	36	5.6	0.02					0.01	0.0179	0.0117	0.057	0.14	1.91	120
4/14/1998	158	12.7		4.6	7.4	110	18	8.6	0.05					0.022	0.0093	0.0065	0.025	0.34 (J)	1.4 (J)	60
7/20/1998	176	8.4	24.2		8.6	120	< 5	3.8	0.06					< 0.001			0.005	0.11	0.64	86
10/22/1998	47.4	7.0	9.2		8.5	150	16	4.5	< 0.01					0.0002	0.0163	0.0108	0.029	0.09	1.14	109
1/25/1999	38.6	9.4		0.9	7.4	170	18	27	0.07					0.014	0.0179	0.0117	0.171	0.07	4.47	120
5/2/1999	-	13.8	13.7		6.5	100	46	44	0.11					0.072	0.0060	0.0057	0.145	0.33 (J)	3.49	51
6/23/1999	-	10.0	16.9		7.7	140	6	6.2	0.03					0.012	0.0126	0.0086	0.016	0.26	0.7	83
10/20/1999	21.5	7.4	11.3		8.1	190	< 5	5	0.02					0.009	0.0224	0.0144	0.036	0.02	0.93	152
1/31/2000	22.4	11.1		12.1	7.7	200	< 5	6.6	0.01					0.005	0.0212	0.0137	0.065	0.03	1.55	144
4/25/2000	169	8.0		12.1	6.9	90	14	11.6	0.04					0.012	0.0074	0.0053	0.017	0.21	1.44	47
7/25/2000	115	8.5	23.2		8.1	130	6	5.5	0.1					0.004	0.0131	0.0088	0.007	0.14	0.52	86
10/23/2000	10.2	10.9	11.4		8	200	72	5.8	0.02					0.009	0.0229	0.0147	0.037	0.05	0.99	156
12/4/2000	23.3	12.7		0.5	8	200	< 5	11.5	0.02					0.005	0.0229	0.0147	0.082	0.08	1.92	156
12/21/2000	16.2	11.7		0.1	7.4	190	6	14	0.02					0.006	0.0228	0.0146	0.138	0.1	3.1	155
1/27/2001	-	2.7		0.1	7	180	< 5	6.5	0.02					0.005	0.0225	0.0145	0.058	0.07	1.24	153
2/27/2001	9.26	7.8		1.0	6.7	240	50	139	0.03					0.015	0.0243	0.0155	0.75	0.91	18	166
3/28/2001	178	10.1		4.0	7.2	150	32	22	0.1					0.017	0.0121	0.0082	0.029	0.17	1.95	79
4/24/2001	182	11.1		4.7	7	120	6	18	0.04					0.029	0.0084	0.0059	0.028	0.79	1.9	54
5/23/2001	195	9.1	14.8		6.7	160	34	21.5	0.1					0.009	0.0119	0.0081	0.012	0.26	0.96	78
6/7/2001	211	9.0	11.8		7.3	160	10	10.7	0.05					0.002	0.0138	0.0093	0.003	0.13	0.42	91
6/28/2001	163	8.6	14.0		7.6	160	8	8.6	0.07					< 0.001			0.006	0.11	0.98	92
7/17/2001	59.5	8.6	17.0		8.3	160	8 (J)	2	0.09					< 0.001			0.002	0.04	0.22	111
8/21/2001	60.4	9.6	18.2		8.1	150	< 5	2.5	0.1					< 0.001			0.001	0.04	0.39	91
9/19/2001	9.5	7.03	14.6		7.8	170	6	4	0.1					< 0.001			< 0.001	0.06	0.52 (J)	116
10/24/2001	9.1	10.14	5.5		7.7	190	< 5	6.2	0.07					< 0.001			< 0.001	0.05	0.57	126
11/28/2001	8.8	14.85		0.2	7.7	240	6	8.6	0.03 (J)	0.0002	0.0066	0.0015		0.009	0.0265	0.0168	0.084	0.04 (J)	1.71	182
12/19/2001	12.4	16.9		0.6	6.8	210	10	24.1	0.02	0.0032	0.0054	0.0013		0.016	0.0225	0.0145	0.098	0.12	5.64	153
1/31/2002	17.78	13.08		1.1	6.7 (J)	190	8	16.7 (J)	0.01	0.0002	0.0054	0.0014	0.0004	0.01	0.0226	0.0145	0.193	0.03	3.85	154
2/20/2002	-	11.08		0.3	7.2 (J)	190 (J)	12	19.1 (J)	0.04	0.0003	0.0043	0.0011	0.0005	0.012	0.0186	0.0122	0.227	0.09	4	125
3/21/2002	56.86	11.01		1.1	7 (J)	140	14 (J)	19.4 (J)	0.09	< 0.0001			0.0001	0.0083	0.0128	0.0087	0.0288 (J)	0.14 (J)	1.93 (J)	84
4/23/2002	168	9.55		9.1	6.9 (J)	110	12	11.7 (J)	0.06	< 0.0001			< 0.0002	0.0143	0.0078	0.0056	0.021	0.3	1.65	50
5/21/2002	131	10.45	7.6		6.8 (J)	120	8	7.7 (J)	0.03	< 0.0002			< 0.0002	0.015	0.0108	0.0074	0.03	0.25 (J)	1.21	70
6/25/2002	175	8.02	18.4		7.7 (J)	160	8	10.6 (J)	0.08	< 0.0002			< 0.0002	0.002 (J)	0.0136	0.0092	0.002 (J)	0.18 (J)	0.36 (J)	90
7/24/2002	122.83	7.86	12.6		7.6 (J)	140	6	10	0.14 (J)	< 0.0002			< 0.0002	0.005	0.0139	0.0094	0.004	0.2	1.35 (J)	92
8/20/2002	68.96	9.23	17.7		7.6 (J)	150	< 5	3.7	0.12	< 0.0002			< 0.0002	0.002	0.0132	0.0089	< 0.001	0.08 (J)	0.34 (J)	87
9/22/2002	16.7	8.99	9.3		6.3 (J)	160	< 5	4 (J)	0.1 (J)	< 0.0002			< 0.0002	0.001 (J)	0.0136	0.0092	0.002	0.05	0.38	90
10/24/2002	7.24	10.14	3.7		6.4 (J)	180	< 5 (J)	2.1 (J)	0.04 (J)	< 0.0001			< 0.0001	0.001 (J)	0.0221	0.0142	0.0017 (J)	0.04 (J)	0.2	150
11/21/2002	14	3.95		4.8	6.1 (J)	200	6	4.9	0.03 (J)	0.0002	0.0058	0.0014	0.0003	0.009	0.0239	0.0153	0.0478	< 0.01	0.94	163
12/19/2002	34	9.09		0.3	7.8 (J)	200	8	11.5 (J)	0.03 (J)	0.0003	0.0055	0.0014	0.0003	0.0206	0.0228	0.0146	0.0872	0.28	1.75	155
1/31/2003	40	6.63		3.6	7.7 (J)	170	14	14.7 (J)	0.06 (J)	0.0003	0.0050	0.0013	0.0005	0.023 (J)	0.0211	0.0136	0.221	0.04	2.42	143
2/26/2003	20.35	8.21		2.1	7.7 (J)	170	20	21.4 (J)	0.04 (J)	0.0001	0.0047	0.0012	0.0003	0.0154 (J)	0.0201	0.0131	0.203	0.03	3.65	136
3/26/2003	-	9.3		3.6	7.3 (J)	130	174	128 (J)	0.21	< 0.0002			0.0004	0.032	0.0115	0.0079	0.128	0.2 (J)	9.51 (J)	75
4/30/2003	-	11.33		6.7	6.8 (J)	90	12	19.5 (J)	0.06 (J)	< 0.0001			< 0.0002	0.0455	0.0070	0.0050	0.092 (J)	0.43 (J)	2.36	44
5/21/2003	136.6	-	16.2		7.7 (J)	100	8	18.5 (J)	0.08 (J)	< 0.0001			0.0001	0.0154	0.0099	0.0069	0.025 (J)	0.27 (J)	1.36	64
5/21/2003					7.7 (J)	100	14	16.3 (J)	0.08 (J)	< 0.0001			< 0.0001	0.015	0.0097	0.0068	0.0233 (J)	0.23 (J)	1.25	63
6/19/2003	161.4	8.24	16.7		7.5 (J)	160	8	8.5	0.09 (J)	< 0.0001			< 0.0001	< 0.01			0.01	0.13 (J)	0.42 (J)	95
7/24/2003	93.7	8.58	18.6		6.9 (J)	160	< 5	3.3 (J)	0.26 (J)	< 0.0001			< 0.0001	0.0034 (J)	0.0144	0.0096	0.002	0.04 (J)	0.29	95
8/28/2003	2.7	4.27	19.6		8.1 (J)	170 (J)	< 5	4.9 (J)	0.12	< 0.0001			< 0.0001	0.0013	0.0183	0.0120	0.0034	0.05 (J)	0.33	123
9/5/2003					8.3 (J)	200 (J)	6 (J)	3 (J)	0.13	< 0.0001			< 0.0001	0.0011	0.0204	0.0132	0.0028	0.04 (J)	0.4 (J)	138
9/15/2003	5.3	4.89	11.9		8 (J)	220	16	10.5 (J)	0.17 (J)	< 0.0001			0.0004	0.0019 (J)	0.0235	0.0150	0.0466	0.02 (J)	2.18	160
10/16/2003	27	11.35	8		8.2 (J)	180	14 (J)	26.8	0.17	< 0.0002			0.0001	0.003	0.0168	0.0111	0.006 (J)	0.07 (J)	1.4	112
11/19/2003	11.21	8.99		5.4	8.5 (J)	160	6	11.2 (J)	0.09 (J)	0.0002	0.0048	0.0012	0.0001	0.0137 (J)	0.0203	0.0132	0.0179 (J)	0.08 (J)	0.74 (J)	137

Table A-9: Selected Water Quality Data - RTWG Site SW-4: EF Owyhee River below Mill Creek

Date	Flow (cfs)	DO (mg/L)	Temperature (Degrees C)		pH	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Total P (mg/L)	Dissolved Cadmium (mg/L)			Total Cadmium (mg/L)	Dissolved Copper (mg/L)			Total Copper (mg/L)	Dissolved Iron (mg/L)	Total Iron (mg/L)	Hardness as $CaCO_3$ (mg/L)
			May-Oct	Nov-Apr						Data	1-hour Criteria	96-hour Criteria		Data	1-hour Criteria	96-hour Criteria				
Criteria		>6	<21	<7	>=6.5 <=9	<500	<25	<10	<0 1	Varies			<0.005	Varies			<0.20	none	<1.0	none
No of Samples		65	35	32	61	61	61	61	60	33	33	33	32	61	61	61	61		61	
No. of Exceedances		7	3	7	4	0	10	31	16		0	2	0	61	17	25	5		35	
% Exceedances		11%	9%	22%	7%	0%	16%	51%	27%		0%	6%	0%	100%	28%	41%	8%		57%	
Average		9.2	14.4	4.2	7 5	160	17	16.3	0.07	0.0003			0.0003	0.0144			0.0758	0.17	2.01	
Median		9.2	14.8	3.6	7 6	160	8	10.0	0.07	BDL			BDL	0.0090			0.0270	0.11	1 35	
Minimum		2.7	3.4	0 1	6.1	90	5	2.0	0.01	BDL			BDL	0.0002			0.0010	0.01	0.20	
Maximum		16.9	24.9	13.6	8.6	240	174	139.0	0.26	0.0032			0.0030	0.0800			0.8900	0 91	18.00	

BDL = Below detection limit

Values less than detection limit assumed to meet water quality criteria (see NAC 445A.144)

BDL levels assumed to be 1/2 BDL for calculating statistics

(J) = indicates that this concentration is an estimated value- it was qualified as such on the basis of QC/QA evaluations such as exceedance of hold time, matrix spike recoveries, serial dilutions, etc.

= water quality criteria exceeded

Table A-10: Selected Water Quality Data - Shoshone-Paiute Tribes Site DV0100: EF Owyhee River at South Reservation Boundary

Date	Sample Time	Flow (cfs) - Sta. 13175100	DO (mg/L)	Temperature (Degrees C)		pH (in field)	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Ortho P (mg/L)	Total P (mg/L)
				May-Oct	Nov-Apr						
7/27/1999		151	9.2	16.9		8.26	142	15	1.5	< .05	0.18
1/19/2000	12:05	24	12.3		0	7.45	188	20	21	0.05	0.11
5/25/2000	12:06	153	8.9	14.4		7.23	158	24	9.1	0.06	0.06
8/7/2001	9:44	53	7.9	17.7		8.09	122	3.0	3.3	0.10	0.10
7/30/2002	12:46	138	9.8	16.6		8.13	116	8	5.8	0.16	0.17
3/12/2003	10:15	22	10.9		5.42	7.43	159	3	3	0.01	0.03
4/15/2003	15:30	85	11.6		7.4	7.16	101	10	10	0.02	0.06
5/22/2003	9:45	129	10.2	10.5		7.3	101	17	10	0.02	0.07
6/18/2003	13:30	156	10.6	15.8		8.24	152	6	6	0.05	0.11
7/22/2003	9:50	97	9.4	18.3		8.12	132	3	2	0.19	0.23
8/18/2003	10:40	3.1	9.3	17.1		8.23	193	5	2	0.08	0.11
9/25/2003	12:40	21	15.3	12.5		8.7	156	11	11	0.10	0.18
10/20/2003	10:00	27	12.9	6.5		7.77	165	16	15	0.08	0.16
11/17/2003	11:30	22	12.3		2	8.28	170	10	9	0.03	0.08
12/17/2003	17:00	18	12.9		0	8	219	10	6	0.01	0.06
Criteria			>6	<21	<7	>=6.5 <=9	<500	<25	<10	none	<0.1
No. of Samples			15	10	5	15	15	15	15		15
No. of Exceedances			0	0	1	0	0	0	5		9
% Exceedances			0%	0%	20%	0%	0%	0%	33%		60%
Average			10.9	14.6	3.0	7.9	151.6	10.7	7.6	0.07	0.11
Median			10.6	16.2	2.0	8.1	156.0	10.0	6.0	0.06	0.11
Minimum			7.9	6.5	0.0	7.2	101.0	3.0	1.5	0.01	0.03
Maximum			15.3	18.3	7.4	8.7	219.0	24.0	21.0	0.19	0.23

BDL = Below detection limit

Values less than detection limit assumed to meet water quality criteria (see NAC 445A.144)

BDL levels assumed to be 1/2 BDL for calculating statistics

[ ] = water quality criteria exceeded